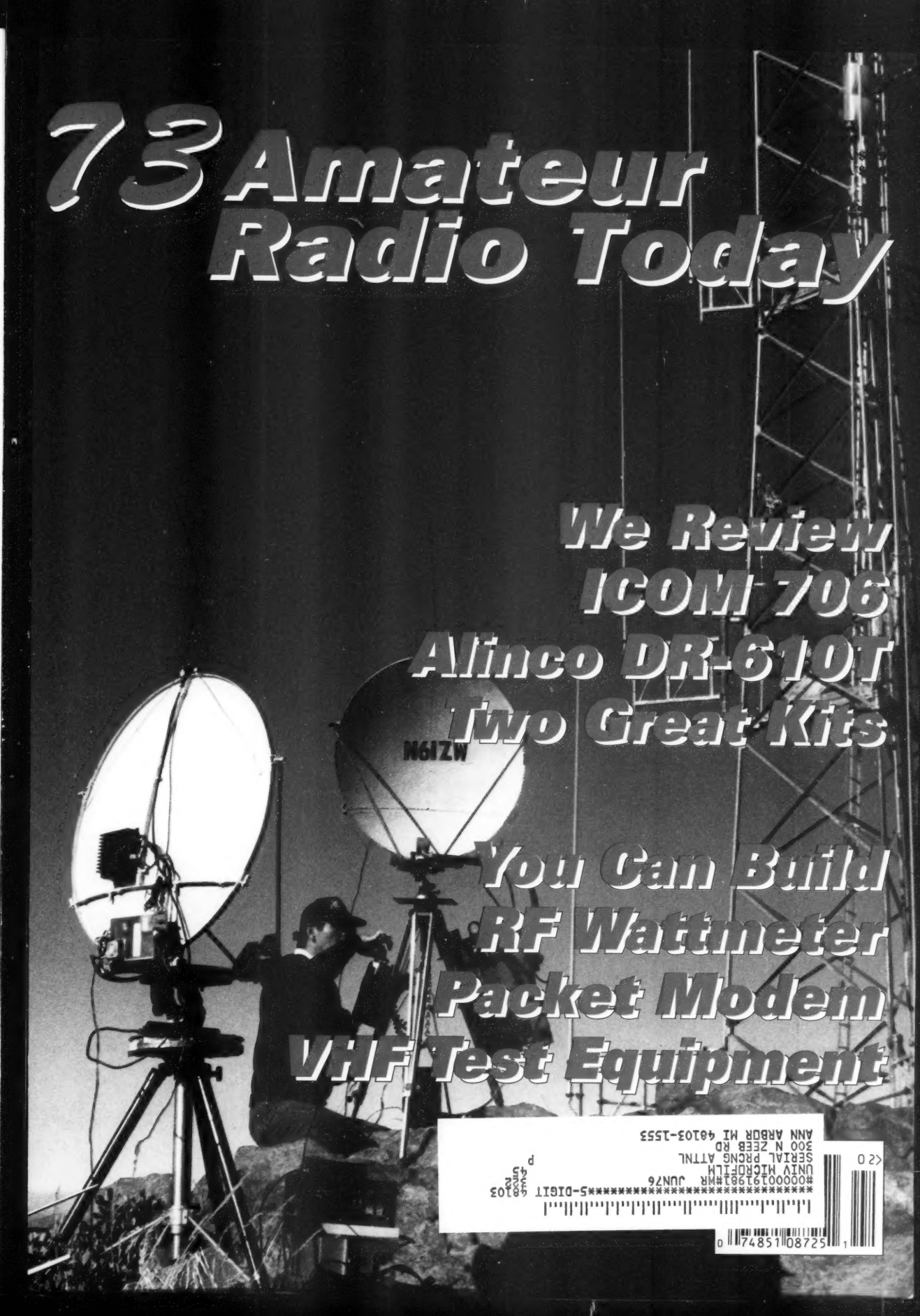
73 Amateur Radio Today



We Review
ICOM 706
Alinco DR-610T
Two Great Kits

You Can Build
RF Wattmeter
Packet Modem
VHF Test Equipment

**********5-DIGIT 48103
#000001919811#MR JUN76
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ANN ARBOR MI 48103-1553

ICOM'S NEW IC-2000H LEADS THE WAY TO CLEAR, CRISP RECEPTION! –

Mobile radios (of all manufacturers) have recently experienced increasing problems from cross modulation interference. This has been caused by the increasing quantity of RF devices (i.e.– mobile radios, paging systems, cell phones, cordless phones, etc...). Commonly known as "intermod", this interference can make a mobile radio unuseable at certain frequencies, depending on local area conditions.

SUPERIOR WIDE BAND RECEIVER CHARACTERISTICS – ICOM's IC-2000H has been specifically designed to deal with this growing problem. A tracking tuning system and high quality RF band pass filters are employed to improve image rejection and intermodulation characteristics. Now you can pursue your hobby in areas previously not possible due to interference. Plus, you're less likely than ever to miss an important call!

ALPHANUMERIC DISPLAY – With the IC-2000H you can program a 6 character name for each memory channel. With the name displayed instead of the frequency you'll have instant ID of memory channels, less confusion and mistakes, and a logical and convenient memory management system.

50 WATT OUTPUT – Work distant repeaters with the IC-2000H. The full 50 watts of output power gives you enough muscle to work most applications. And when you don't need as much power, such as when working a close station, you may choose a 5 or 10 watt output power setting.

"ONE-PIECE" CONSTRUCTION – ICOM gave the IC-2000H a rugged "one-piece" die cast aluminum frame and our largest heat sink ever. Now you'll get dependable, stable transmissions in extreme environments. Plus, any heavy duty cycle operation is no problem.

PRICE PERFORMANCE – Even with its high quality construction, great features and exceptional performance, the IC-2000H is one of the most economical 2 meter FM mobiles around. You'll get real value for your money. Come check it out today. For more information about the intermod-fighting IC-2000H, visit your local ICOM dealer, contact ICOM Technical Support in the HamNet forum on CompuServe© @ 75540,525 (Internet: 75540.525 @ compuserve.com) or **CALL ICOM'S BROCHURE HOTLINE: (206) 450-6088**

Superior Wide Band Reception!

IC-2000H

HIGHLY INTERMOD RESISTANT

• FEATURES •

- 50 W of power (50, 10, 5 selectable)
- Rx 118-174 MHz (118-136 AM, 136.1-174 FM)
- Tx 140-150 MHz (for MARS/CAP)
- AM aircraft receive
- Alphanumeric display
- Message paging
- 50 memory channels
- 2 scratch pad memories
- 6 scan edge memories
- Full scan + program scan
  - 5 scan resume conditions
  - Call channel
  - Busy channel lockout
  - Auto power off
  - Scan modes and priority watch
  - Programmable up switch
  - DTMF mic included
  - "One touch" button operation
  - Separate volume and squelch knobs
  - Alpha message paging (UT-55 required)
  - Tone scan (UT-85 required)
- Code squelch/pager (UT-101 required)
- Tone squelch/pocket beep (UT-85 required)

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MFJ *HF/VHF* SWR Analyzer™

. . . Read your antenna SWR from 1.8 to 170 MHz . . . built-in 10 digit LCD frequency counter. . . RF Resistance Meter™. . . smooth vernier tuning . . .

MFJ-259 **$239.95**

MFJ-259 handheld *Univeral SWR Analyzer™* lets you read your antenna SWR from 1.8 to 170 MHz quickly and easily without any other equipment!

MFJ's exclusive *RF Resistance Meter™* lets you measure RF resistance up to 500 ohms at minimum SWR.

Has built-in 10 digit LCD frequency counter and smooth vernier tuning.

You get *four* instruments in one . . . 10-digit frequency counter . . . RF signal generator. . . SWR Analyzer™. . . *RF Resistance Meter™*

Measure antenna resonant frequencies and 2:1 SWR bandwidths. Adjust mobile antennas, antenna tuners and matching networks in seconds.

Measure RF resistance, inductance, capacitance, resonant frequency of tuned circuits, transmission line velocity factor /impedance/ loss. Test RF chokes,baluns.

MFJ-209, $109.95, same as MFJ-259 less frequency counter and *RF Resistance Meter™*

See *free* MFJ catalog for complete line of MFJ SWR Analyzers™.

MFJ-949E 300 W Tuner

MFJ-949E **$139.95**

World's most popular antenna tuner covers 1.8-30 MHz, has lighted *peak/* average Cross- Needle SWR/ wattmeter, 4:1 balun for balanced lines and *full size* 300 watt dummy load.

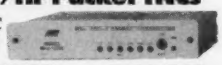
Versatile 8 position antenna switch lets you *pre-tune* MFJ-949E into dummy load to minimize QRM.

Custom inductor switch was carefully engineered to withstand extreme voltages and currents.

Cabinet is chemically etched to MFJ's bond tough *baked-on* paint.

VHF/HF Packet TNCs

MFJ-1270C **$119.95**



MFJ-1270C *super* TAPR TNC clone has a world wide reputation as *the most reliable packet TNC in the world* -- many work 24 hours a day for years without a single failure!

Fully TAPR TNC-2 compatible, VHF *and* HF operation, *free* AC power supply, new *enchanced* mailbox expandable to 512K with auto/reverse mail forwarding, WeFAX mode lets you print weather maps, optional plug-in 2400/9600 baud modems, KISS interface, ***now GPS compatible.***

MFJ TNC/Mic Switch

MFJ-1272B **$39.95**

Switch between your TNC or microphone by pushing a button!

Just plug pre-wired cables into your rig's mic connector and TNC.

Plug-in jumpers let you use nearly any rig with 8 pin mic connector.

MFJ-1272B/MFJ/TAPR TNC2 clones;
MFJ-1272BX/PK-232;
MFJ-1272BYV/KAM VHF/KPC3;
MFJ-1272BYH/KAM HF Port;
MFJ-1272BZ/PK-88, $39.95 each.
For 8 pin RJ45 modular phone jack replace B with M in model number above.

Regenerative RCVR Kit

MFJ-8100K ***kit*** **$59.95**
MFJ-8100W ***wired*** **$79.95**

Build this *regenerative* shortwave receiver *kit* and listen to shortwave signals from all over the world with just a 10 foot wire antenna.

Has RF stage, vernier reduction drive, smooth regeneration, five bands.

MFJ-1278B Multi-Mode Data Controller

MFJ-1278B **$299.95**

Use this MFJ-1278B, your transceiver and computer to transmit and receive digital communications! You'll discover a whole new world of ham radio and communicate in ways you never knew existed on our ham bands.

The *world class* MFJ-1278B Multi-Mode and MultiCom™ software is packed with features *no other* multi-mode gives you.

You get *10 digital modes* . . . Packet, AMTOR, PACTOR (at no extra cost), RTTY, ASCII, Navtex, Color SSTV, 16 Gray Level FAX, CW and Memory Keyer plus an *enchanced* 32K Mailbox.

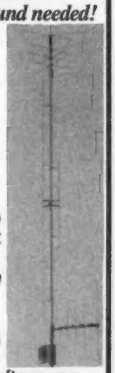
You'll have fun joining worldwide *packet* networks and exchanging *color SSTV* pictures with your buddies around the world. You'll marvel at *full color FAX* news photos as they come to life on your screen. You'll see weather changes on highy detailed *weather maps* in all 16 gray levels. You'll eavesdrop on late breaking news as it happens on *RTTY*. You'll enjoy error free HF QSOs on *PACTOR* and *AMTOR* and receiving packet mail in an *enchanced 32K mailbox*. Want to copy some *CW*? Just watch your screen.

MFJ-1289, $59.95, MultiCom™ software and cables.

MFJ *halfwave vertical* Antenna

6 bands: 40, 20, 15, 10, 6, 2 Meters . . . No radials or ground needed!

MFJ-1796 **$199.95**



Operate 6 bands -- 40, 20, 15, 10, 6 and 2 Meters --with this MFJ-1796 *ground independent* halfwave vertical antenna! No radials or ground ever needed!

It's only 12 feet high and has a *tiny* 24 inch footprint! You can mount it anywhere from ground level to the top of a tower -- on apartments, condos, small lots, even on motorhomes. Perfect for vacations, field day, DX- pedition, camping.

Frequency selection is fully automatic -- all you do is transmit. Its *low angle of radiation* really reachs out and brings in DX. Omni-directional. 1500 watts PEP.

Efficient *end loading*, no lossy traps. *Entire length* is always radiating. *Full size* halfwave on 2 and 6 Meters. High power *air-wound* choke balun eliminates feedline radiation. Adjusting one band has minimum effect on other bands. Add $20 s/h.

Easy to assemble -- you'll have it on the air in an afternoon.

MFJ's *world famous* 3 KW Versa Tuner V

MFJ-989C **$349.95**

Here's why the MFJ-989C is the finest 3 KW antenna tuner money can buy . . .

Two *massive* 250 pf transmitting variable capacitors can handle *amps* of RF current and *6000* RF volts. Logging scales.

Precision ball bearing roller inductor, three digit turns counter and spinner knob give you exact inductance control for minimum SWR.

Lighted *peak*/average Cross-Needle SWR/Wattmeter has 200/2000 watt ranges. Super heavy duty *current* balun has two giant 2½ inch powder iron toroid cores wound with *Teflon®* wire.

Six position *ceramic* antenna switch has extra large contacts. Flip stand, dummy load, one year *unconditional* guarantee, aluminum cabinet, tough *baked-on* paint, locking compound on nuts/bolts, handles 3 KW PEP, 10½x4½x15 in. Meter lamp needs 12 volts. Add $13 s/h.

MFJ *No Matter What™* Guarantee

MFJ's famous one year *No Matter What™ unconditional* guarantee means we will repair or replace (at our option) your MFJ product sold in this ad *no matter what* for a full year.

Super Hi-Q Loop Antenna

MFJ-1786 **$299.95**

Tiny 36 inch diameter high efficiency loop antenna covers 10-30 MHz *continuously* with low SWR. Handles 150 watts.

Ideal for home installations where space is limited-- apartments, condos, small lots. Take on trips.

All welded construction.

Remote control has *Automatic Band Selection™*, Cross-Needle SWR/ Wattmeter. No control cable needed. Use batteries or 110 VAC. Add$20 s/h.

No ground or tuner needed.

MFJ-1782, $269.95, like MFJ-1786 but remote control has only slow/fast tune buttons.

Dual Band Mobile Ant.

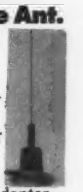
Mobile Antenna for 144/440 MHz

MFJ-1724B **$14.95**

MFJ *dual band* magnet mount mobile antenna for 144/440 MHz has 19 inch stainless steel radiator, low SWR. For mobile rigs with SO-239 UHF connector *and* handie-talkies with *included* BNC adapter.

5/8 Wave Mobile Ant.

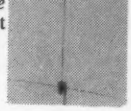
MFJ-1728B **$24.95**



Maximum Gain™ 5/8 Wave 2 Meter *magnet mount* mobile antenna has stainless steel radiator, 12 ft coax, low SWR.For mobile rigs with SO-239 UHF connector *and* handie-talkies with *included* BNC adapter.

5/8 Wave Ground Plane

MFJ-1750 **$19.95**



$19.95 gets you a 2 Meter 5/8 wave ground plane *home station* antenna! You get the highest gain of any single element antenna, shunt fed matching, ceramic insulators.

MFJ-1752, $19.95, for 220 MHz.

Free MFJ Catalog

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J-Pole in your Pocket?

Tough dual-band antenna for the travelin' man or the condo dweller. Hang-anywhere style and extra range can save life in an emergency.

James H. Gray W1XU

During my years of traveling around the eastern United States on business or vacation, I often wished I had a small, inexpensive and easy-to-use antenna to match my little handheld 2 meter radio. Occasionally I had an HF rig in the car, but more often it was the little 2 meter radio which was useful and fun. On long road trips it alleviated boredom, kept me awake and almost always assisted me to find a motel, restaurant, or other ham's QTH. On such trips the mobile antenna was fine until I needed more range from the motel.

When I traveled by plane, the rig was the handheld with no amplifier. It had only a small telescoping whip that I could extend to about 19 inches. If I happened to be close enough to a repeater in a large city, that was fine and I managed to "work" the locals in spite of low power and a minimal antenna.

But there were occasions when there was no local repeater, or when I was inside a steel-and-concrete building. At such times I wasn't able to make any contacts at all and had to resort to dull tedious television programs before going to bed.

If you face similar problems when traveling light and by air, you know how it feels to be alone among the many.

The Pico Solution

Today, the travelin' man has a ready solution to the problem: a neat antenna produced by Antennas West and called the "Pico-J." It meets all the requirements set forth in the first sentence. Pico means "small," as in "picofarad," and "J" stands for "J-pole," the well-known low-angle, omnidirectional vertically polarized antenna—just what's needed for 2 meters.

Antennas West's Pico-J offers some features not found in the usual J-pole. For example, the feedpoint is already found and matched for you, and the antenna is small and light—so much so that it can be rolled up and slipped into a small eyeglasses case. It looks like a sleek black ribbon 55 inches long. A six-foot small-diameter coax feedline comes off the bottom. Its gold-pin BNC attaches directly to your radio.

A small loop at the top may be slipped over a curtain rod or a nail or any other suitable projection. But, if by chance you don't happen to find a suitable support, Antennas West thoughtfully provides a small suction cup with an embedded hook that can be slapped up on a window or any smooth surface, and presto!—you're on the air!

Pico-J is completely weather-sealed and could be hung outdoors if you wish. Otherwise, you can hang it in a closet or a doorway; in fact, anywhere that is convenient and where your signal won't be blocked. The extra reach provided by this beauty could save life in an emergency, and is always useful when just plain chatting with the locals.

Your Pico-J stretches range, improves reception, reaches far-away repeaters, and saves your battery pack.

The measured VWSR is less than 2:1 between 142 and 150 MHz—ideal for CAP, MARS, and other services near the 2 meter band—and is a very beautiful 1:1 at 146 MHz. Not bad, eh?

Best of all, considering the benefits, is the price: $19.95 for the 2 meter model, $26 for the 2m/70cm dual bander, both complete with the soft vinyl case to store your Pico-J when it's not in use.

On a recent trip I tucked Pico-J into my briefcase, right next to the handheld. No, I didn't even use the "duckie" or the telescoping whip because I had all I needed in this one neat antenna. Maybe you'll find the same.

–condensed from ***RadioFun***

PASS THIS TEST!

WIN $5

Clip this ad and circle the TigerTail™. Send it with your order to get $5 off any purchase.

Can You Find theTiger'sTail?

If your eyes are sharp you can spot the **TigerTail**™ in the photo above. It's not attached to something that bites; instead it puts extra growl into the signal from the HT it's attached to.

TigerTail™ improves SWR, lowers radiation angle, and extends range. You can use low power and save your battery pack, but still have a big signal.

Better than an amplifier, it improves reception too. **TigerTail**™ does all this by simply slipping under your flex antenna and just hanging down— without sticking up or out or getting in the way.

No Antennas Allowed?

Who will see ***Pico-J*** *hanging in your closet or on the balcony? But your signal will be heard.* ***Pico-J****'s half wave radiator is sleek and unobtrusive. his thin flexible feedline is barely noticeable. When his work is done Pico-J rolls up and slides into his pouch like the Genie slipping back into the bottle.*

Carry ***Pico-J*** *on hikes or trips as you would carry a pair of glasses. Keep him in your emergency jumpkit. When you need gain and low angle omnidirectional coverage pull out* ***Pico-J*** *and be full quieting when it counts.*

New Pico-J's for 1995

PJ Packet $22—*Maximum efficiency on 2m packet frequencies.*

PJ 220 $19.95—*Go everywhere gain for the "private" band.*

Pilot's Pico-J $39—*Aviation band range booster for pilots on the go.*

☐ **Yes, I want to increase range and save my batteries!**

___Send my Pico-J. 2m or 220=$19.95, Packet=$22, Dual=$26, Pilot=$39.

___Send my TigerTail. (1 for $7.95, 2 for $15, 3 for $21. Specify band)

___Send a combo (PJ + TT). (Just add $5 to your Pico-J order)*All prices ppd.*

☐ **Yes, I circled the TigerTail! Knock $5 off my order.**

Name_____

Call_____ Phone_____

Street_____ Unit_____

City_____ State_____ Zip_____

Antennas West Box 50062-S Provo UT 84605

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Order Hotline **800 926 7373**

CIRCLE 57 ON READER SERVICE CARD

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FEBRUARY 1996
ISSUE #425

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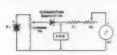
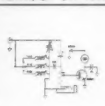
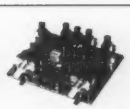


On the cover: Kerry N6IZW microwaving near Mt. Laguna CA to Mt. Union AZ. See story on page 20.

Feedback: Any circuit works better with feedback, so please take the time to report on how much you like, hate, or don't care one way or the other about the articles and columns in this issue. G = great!, O = okay, and U = ugh. The G's and O's will be continued. Enough U's and it's Silent Keysville. Hey, this is *your* communications medium, so don't just sit there scratching your...er...head. FYI: Feedback "number" is usually the page number on which the article or column starts.





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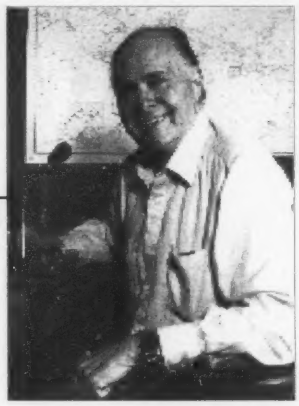
NEVER SAY DIE

Wayne Green W2NSD/1



So Few Pages

There are so many interesting things to write about that I wish I had 20 pages a month. If I could stop myself from writing so much I'd look into setting up a web page. But the more I read and talk with the experts in many fields, the more I want to let you know what's going on.

This month I'll bring you up to date on the incredible developments in cold fusion. And my theory for why cold fusion is happening. I've got what seems to me the first rational explanation for why we have inertia and gravity. But then most people don't know that scientists don't know.

And I want to tell you about my drive around London on a magnet-powered scooter which defies the law of conservation of energy. And about my trip to Stonehenge.

I've some advice on how to build ham club attendance, and more news on ways we're slowly poisoning ourselves. This time its those pesky fluorides.

I've been doing a brisk business in my booklet of editorials written for *73* that haven't yet been published. It's running 32 pages of even smaller type than this, but I'll have to expand it to keep up with my output. Some of the material is ham-oriented. There are 46 of my editorials in the $5 booklet, but it'll probably be up to 60 by the time you read this — if the mail from that W6OBB radio talk show interview I'll be telling you about ever slacks off!

Cold Fusion Update

It's been quite some time since I've written about what's been happening in the cold fusion field. It has not been standing still.

For those with short memories for trivia, the cold fusion phenomenon was announced by Professors Pons and Fleischmann of the University of Utah in 1989. They claimed that by passing a small amount of current through a palladium cathode in a lithium and deuterium electrolyte they had produced a substantial amount of excess heat for which there was no good chemical or physical explanation.

"Yep, one thousand times more output than input!"

Several universities tried to replicate the experiment. Most failed, triggering a media stampede ridiculing Pons and Fleischmann. The U of Utah canceled their funding and dumped them. What wasn't made public was that many of the universities which "failed" to confirm the cold fusion process were getting generous funds for hot fusion research. If cold fusion was really true, the schools involved stood to lose millions. Also hushed up were the reports from several universities confirming the P&F results.

The controversy pretty well stopped the funding for American cold fusion research. Scientists in other countries, with Japan leading, continued to pursue the idea, getting substantial government funding for their work.

In late 1993 I became convinced that despite the media reports, cold fusion was not just a fact, but looked like it would eventually be able to supply energy at a fraction of the cost of fossil fuels such as coal and oil, and without the pollution these sources generate. With known fossil resources dwindling, this new energy source was coming along at the right time. But how would the world change if energy could be generated at a tenth or less the cost of energy today? Imagine cars requiring almost no fuel. Planes. Ships. Space ships.

So I attended the Fourth International Conference on Cold Fusion (ICCF-4) on Maui in December 1993, where I announced I would be starting a magazine to help researchers communicate, to provide a forum for physicists to argue over the theory of what was going on, to help newcomers to the field come up to speed, and to allow potential investors to find the ground floor scientists to support.

The field was alive and well during 1995, with international conferences being held in Boston (MIT), Monaco (ICCF-5), Bombay, Tokyo, Molise (Italy), and Sochi (Russia).

The leading light in the US is Dr. Jim Patterson of Sarasota, an inventor who got patents on his innovative cold fusion cell. He made microspheres of plastic and coated them only microns thick with palladium. The result was that his cells were able to start generating excess heat in minutes instead of days to weeks, as required by the use of solid palladium. He demonstrated his cell at Monaco, with the cell and instrumentation out in the open for everyone to check. His cell was generating about six times more energy out than it took to trigger it. And he was using plain water instead of the much more expensive deuterium!

Six months later, at a fusion conference at the University of Illinois, his demonstration cell was turning out 100 times more energy than required to run it! This was confirmed by the scientists from 35 countries attending the conference.

Two months later, in December 1995, the Patterson Patented Cell (PPC) was demonstrated at the Power Gen conference in Anaheim, where the top brass from power companies all around the world saw Jim's cell perking away, with one watt of power going in and 1,000 watts of heat being generated as a result. Yep, one thousand times more output than input! Let's see the cold fusion critics attribute that to errors in measurement. Jim's company is Clean Energy Technology Inc. (CETI). How'd you like to have a piece of *that* action?

Yes, the utility bigwigs sure paid attention. Several major companies are dickering with CETI for licenses to develop power systems using the Patterson technology. And CETI will get a piece of the action on any developments of their basic system. Early investors could reap billions from a fairly modest investment. The readers of my *Cold Fusion* were alerted so they could get in on the ground floor of this one, with the full information on the PPC in issue #7, back in March 1995.

Of course it's going to be years before we no longer need power lines, are running around with cold fusion powered wrist communicators, and so on.

The Heat Source?

The standard model for the atom and classical physics doesn't explain what's happening. This is one reason the scientific establishment pooh-poohed the P&F claims, humiliating them. So when a division of Toyota came along and offered to build them the laboratory of their dreams anywhere in the world, they ended up on the French Riviera. And Toyota ended up with a good chance at having the first car needing no fuel. We'll see. P&F are now being very secretive about their progress. That could be because they aren't making much progress, or because they are.

I've run a series of articles in *Cold Fusion* by some top scientists on what they think is going on. My own theory is that the excess heat is the result of a transmutation of elements in the palladium metal's lattice. Yep, alchemy. This would explain why there's some helium being generated, but not enough to explain the amount of excess heat. The universities of Illinois and Missouri are checking the Patterson celis to see if there are any other transmutation products. I predict they'll find beryllium, which will be a product of hydrogen and lithium, and some silver resulting from the transmutation of palladium and hydrogen. These reactions would easily account for the excess heat being generated, as well as the lack of radioactive products. This is cold fusion, working from the lower end of the periodic table, not cold fission, working from the top down.

The reaction is kept gradual since it is happening in the metal lattice. A fast reaction could be explosive, and we've seen some signs of that potential, with some lab experiments blowing up. One killed a scientist who was in the wrong place at the wrong time.

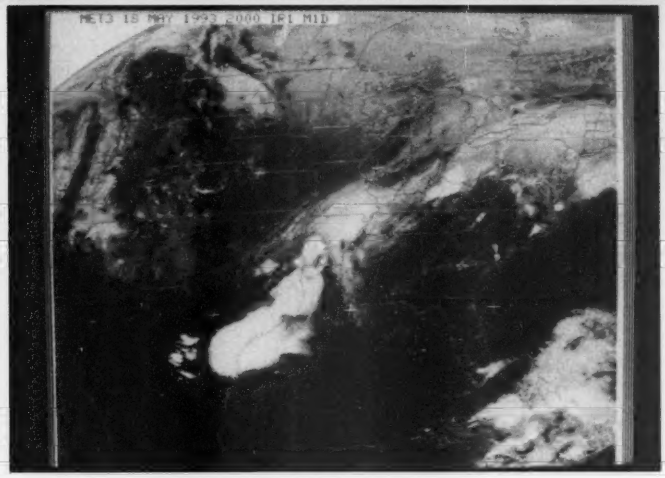
Inertia and Gravity

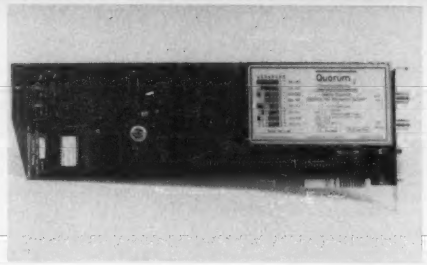
What *is* matter? Well, it's energy of some sort. We really don't know what matter is (yet), but like quality, we know it when we see it.

The cold fusion reaction has called into question the so-called standard model of the atom. A lot of verities are being called into question these days, despite the ear-plugs

Continued on page 74

Explore The World of Quorum Wefax





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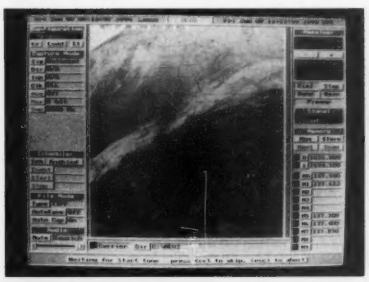

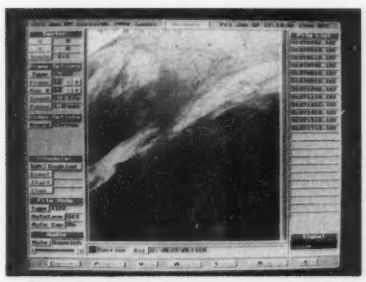

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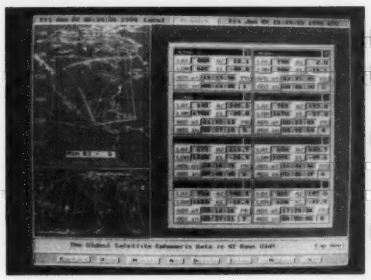

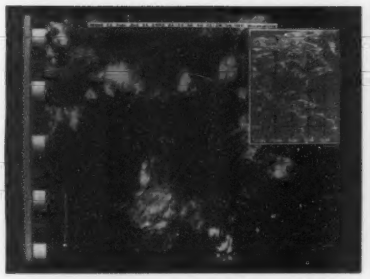

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LETTERS

From the Ham Shack

Jack Conway N5YIS. I never go to hamfests, so I thought that I would never have an opportunity to hear you speak. When I read in *73* that you had a tape for sale, I just had to have one. Here is my five bucks: After reading years of good money-making ideas from you I thought I would send you two that you can have free of charge. Your offer to sell back issues of *73* was tempting, but like most people I don't have room for any more magazines. I do, however, have room for more CD-ROMs, so why don't you scan all your back issues onto CD ROM's and sell them? I know I would buy them just to read all the editorials. Why don't you put your audio publishing house to work putting together a Morse code CD? Reading the different magazine I read, I have always wondered why nobody put together a Morse code trainer on CD. Most CD players have a random play feature. I think it would be the best medium for practicing code. Keep cranking out the quality editorials.

Sure, I'll bet I could sell dozens of CD-ROMs of the back issues. Let me know if you'd like to scan in the 50,000 pages for me. Or maybe I could get some retired ham to scan in my over 1,000 editorials. I'll bet I could sell scores of those on a CD-ROM. We did a CD-ROM listing of every known CD back in 1989 and sold dozens of 'em. We even scanned in the color covers for hundreds of 'em, and had sample tracks of the music. It sold like cold cakes. The code? All it takes is one one-hour tape at 13 per to learn the code from scratch. And one at 20 wpm for that speed. Why would anyone put an hour of code on a CD when a tape does it just fine? . . . Wayne)

Dave Kaun N9KMY. It is truly time for our hobby to move into the new technology age. We need to substitute application of technical skills for Q&A manual memorization and the copying of the code as a method of advancement. Memorization, popular as a teaching method in previous generations, is no longer the way learning takes place today. While we expect our youngsters to understand and apply huge amounts of technical information, why are we still requiring memorization in amateur radio? Let's make our hobby a natural learning progression for technically literate students interested in what ham radio offers.

After many years of being involved with electronics as a hobby and as my career, I became a Technician before the no-code license was offered. To me the technical side of the hobby is much more important, though I would enjoy working HF if it were not for the artificial barrier the code presents. I find it quite interesting that many who once long ago learned the code can't carry their side of a technical conversation equal to the license they hold nor even remember the code well enough to use it. More than memorization is needed today to understand technology; just ask any engineering student if formula or fact memorization is enough. Learning and understanding applications is much more important. We need to follow that same methodology of learning in amateur radio. Keep up the good work and the excellent magazine.

Philip Weaver VS6CT. Wayne, it's been awhile since our paths crossed. I am leaving for the CRSA DX Convention in Beijing later today and was remembering how we met in the BY1PK Radio shack in Beijing back in 1984, when I was assisting with the communications associated with the Hong Kong-to-Beijing "555" Car Rally. I retired from the Hong Kong Government in February of this year and I have not stopped since. I will be dashing around Asia for the next two months, with visits to Bali, Thailand, Hainan Island on the South Coast of China, and Kota Kinabalu. I sold my flat here in Hong Kong and will be leaving for England in December to join the QE2 out of Southampton for a four-month round-the-world cruise. I am hoping that I will have managed to organize the setting up of a ham station on board and am awaiting word from Chip Margelli of Yaesu to supply me with a radio as the official sponsor of the station. I'll return to England in mid-April and expect to be back out here in Hong Kong in late May to try to find a flat where I can put some decent antennas on the roof. I am very bullish and optimistic about the future of Hong Kong, which is why I want to stay here, apart from the advantages of being somewhere that I know. I've enjoyed living here for 22 years. I just hope that my faith will be justified in the future. I still read your editorials with enjoyment, I just wish that they could produce more results. Keep at it Wayne.

Phil, I hope your trust of Beijing not ruining Hong Kong is justified. It's too bad the changeover isn't in 10 more years, after China has had an opportunity to adjust to capitalism. . . Wayne)

Sharon Cenna KB8VXL. I just finished reading your September editorial. You have a lot of valid comments. You ask why ham radio isn't growing and why so few hams read the magazines. Well, I'm a new ham and I've found very few hams willing to Elmer (or Elmira). No one is volunteering to give demonstrations or workshops at the local schools or clubs. Even giving a demo on a parent/teacher night could be fun and enlightening. As for community service, CB usually provides help faster than 2m. All this prevents young people from learning about amateur radio. Have you heard of any ham groups anywhere in the country teaching kids how to come up with their own electronic inventions, techniques, or computer connections? I guess the only person I can change is me, so I better get going doing something creative in my own square of dirt, then share it with the next person I meet, and keep going.

I keep scanning the club newsletters, hoping to see some signs of responsibility for growing our hobby, as you've suggested. Nope, they're all busy having fun. No school or local club demos. Now and then a group will put on a demo at a shopping mall, but those that I've visited were very visitor unfriendly. Sure, the hams were having fun, but they made no effort to communicate this to visitors. I've talked with school kids in many schools about the fun we have to offer. I've talked to over a hundred service clubs about it all over New Hampshire and Massachusetts. But I feel I'm waging a one-man fight, with no visible support. . . . Wayne

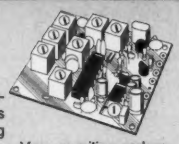
Glenn Hammond Sr K4YDG. I have been a loyal *73* reader since the first issue came out in 1960. I was 12 years old at the time and earned the money to buy the magazines with my morning paper route. I also read *6-Up*, your VHF magazine, until it ceased publication. You made enough of an impression on me that I earned my Novice ticket in 1960 and steadily became more interested in electronics. During the Vietnam War

Continued on page 31

QSL Contest Winner!

Page Perrin KG6JY combines two of his hobbies in this QSL. Page says, "By combining my two favorite hobbies, amateur radio and hang gliding, I'm able to have much safer and enjoyable flights. Air-to-air communications with other ham-licensed pilots about lifting air conditions, and air-to-ground contact for critical wind information just prior to landing make me glad I became a ham. Packet GPS will allow hang gliding pilots to fly cross-country and automatically report their position to their chase vehicle, or in an emergency to rescuers. Staying up for hours and flying hundreds of miles has become commonplace in the sport. That's Mt. Shasta in Northern Californa behind me. It is about 80 miles away."

WWV RECEIVER



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**Specify tuning range: 26-30, 46-56, 137-139, 139-152, 152-172, 210-230, 400-470, 800-960 MHz.*

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- **Low-cost** MOSFET preamp.
- **Small size.** Only 5/8"W x 1-5/8"L x ¾"H.
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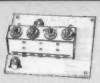
**Specify tuning range: 25-35, 35-55, 55-90, 90-120, 120-150, 150-200, 200-270, 400-500 MHz.*

HELICAL RESONATORS



Helical resonator filters may **reduce your intermod & cross-band interference.**

MODEL HRF- (*), *$59 vhf, $99 uhf.*

**Specify tuning range: 136-140, 142-150, 150-162, 162-174, 213-233, 420-470.*

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- Input ranges avail: 50-52, 136-138, 144-146, 145-147, 146-148, 220-222, 222-224 MHz, 432-434, 435-437, 435.5-437.5, and 439.25 (atv conv. to chan 3).
- **Kit less case *$49*, kit w/case & BNC jacks *$79*, w&t in case *$99*.**

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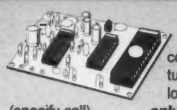

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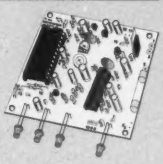

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COR-3. COR, timers, court.beep .... **kit $49**

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COR-4. Complete COR and CWID all on one board. CMOS logic for low power consumption. EPROM programmed; (specify call) ..... **kit $99, w&t $149**

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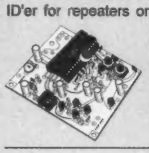

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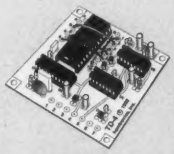

TD-3 CTCSS DECODER/ENCODER. Prevents access to repeater or receiver unless proper tone is present. Tone output for transmitters, too. ..... **kit $29, w/t $59**

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XMTRS & RCVRS FOR REPEATERS, AUDIO & DIGITAL LINKS, TELEMETRY, ETC.

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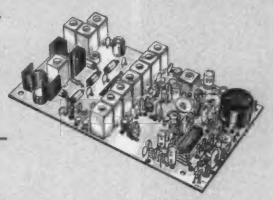
FM EXCITERS: 2W continuous duty. *FCC type accepted for com'l bands.*



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Either model: .....**kit $99, w/t $169.**

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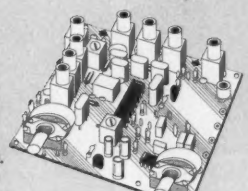

NEW **R100 FM RECEIVERS** for 46-54, 72-76, 140-175, or 216-225 MHz. **Very sensitive** – 0.15uV, **exceptional selectivity** – both crystal & ceramic if filters for >100dB at ±12kHz (best available anywhere), **flutter-proof** squelch. .....*New low price!* **kit $129, w/t $189.**

- **R451 FM RCVR,** for 420-475 MHz. Similar to above. *New low price!* **kit $129, w/t $189.**
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R139 Is The Affordable WeSat Rcvr!

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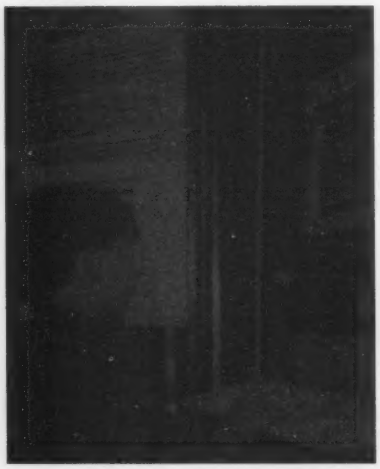
QRX . . .

ITU Nixes Code Change

New Zealand proposed the deletion of the Morse code requirement from the ITU amateur radio regulations, but the move was opposed by the American delegation, which was notable for the number of ARRL members on the delegation. The matter has been tabled until some future ITU conference. The success of the ARRL in preventing this move was expected, since it has rather tight control over the International Amateur Radio Union (IARU). But a growing number of countries would like to have the ITU amateur regulations more in tune with today's technology and not continue as a monument to the long past.



Nine-year-old Brian Kearns KC7MLW operating the CARL station.

Science Center Ham Exhibit

The Center for Amateur Radio Learning (CARL) successfully finished its first summer at the Arizona Science Center. The exhibit was located within the Tech-zone at ASC. The station featured an HF installation with a triband beam and a VHF packet station. With the help of over 40 volunteers from the Arizona amateur radio community who volunteered their time, visitors were able to speak with hams around the world.

The next CARL goal is to set up a permanent station at ASC's new facility, which is scheduled to open early 1997. The station will be state-of-the-art and will employ as many modes of amateur radio operation as possible, including satellite, HF, packet and ATV. Along with the station there will be an area set aside for visitors to build electronic projects such as crystal radio sets.

CARL is in the Arizona Science Center, which is dedicated to exposing children and adults to science and technology in a friendly hands-on manner. Approximately 500,000 visitors pass through ASC each year, with over being children. Technology has become an essential part of our society and exposing children to radio communications and electronics can lead to a lifelong interest in science. This is an opportunity not only to recruit new amateur radio operators, but also a project which can lead young people to careers in high-tech fields.

CARL is seeking help in raising the $50,000 needed to complete the project. Barry Goldwater K7UGA and Lou Grubb WA7HZO have offered their names and support for the project. Donations to the project are tax-deductible, and donated radio equipment may either be used at the station or sold for proceeds. If you would like to help please call Ralph Barr W0DNO at (602) 582-8208. In the Phoenix area join their net every Tuesday at 8:00 p.m. on 145.35 MHz, via the DAWN repeater. *TNX Rick Horwitz AB7FH.*

Hooray Oregon!

Features with young hams are what we need in every newspaper in the country. Congratulations to the hams in Oregon for getting this priceless PR in *The Oregonian.* The article points out how much fun the youngsters are having with inexpensive equipment, while learning about electronics and making new friends. Thanks to Steve Brose WA7EZB for sending the clipping.

Ham Towers Legalized!

Well, at least in Massachusetts. Governor Weld signed H-2782 into law. It states that, "No zoning ordinance or by-law shall prohibit the construction or use of an antenna structure by a federally licensed amateur radio operator. Zoning ordinances and by-laws may reasonably regulate the location and height of such antenna structures for the purposes of health, safety, or aesthetics; provided, however, that such ordinances and by-laws reasonably allow for sufficient height for such antenna structures so as to effectively accomodate amateur radio communications by federally licensed amateur radio operators and constitute the minimum practical regulation necessary to accomplish the legitimate purposes of the city or town enacting such ordinance of by-law."

Don't just sit there nodding in agreement, get your legislature to enact a similar law to help back up the FCC's PRB-1.

Updates

In the November 1995 issue, page 20, "A Simple Wattmeter." Yes, the diodes D1 and D2 are drawn backwards. The author had 'em wrong and it didn't get caught until a reader spotted it.

In my November editorial, page 74, I gave the phone number for Marcus Books. Since then the prefix has changed from 416 to 905. You can order *Maximize Immunity,* and other Marcus books, via 905-478-2201. Good luck on finding anyone there to answer. But you really should read the immunity book for your and your family's health, no matter...Wayne.

Feedback

In our continuing effort to present the best in amateur radio features and columns, we recognize the need to go directly to the source—you, the reader. Articles and columns are assigned feedback numbers which appear at the top of each article/column's title page. On your QSL card (or a regular postal card or letter), please write the number of the article or column about which you are critiquing and include the cover date of the magazine. Make it simple, indicate: Great, OK, or No Way. And let us know what you want to see more of or less of. If you want to write something at length, that's okay too. You may critique as many articles or columns as you want, but please only mention one article or column per card.

Do we really read the feedback cards? You bet! The results are tabulated each month, and the editors take a good, hard look at what you do and don't like.

Each month we'll draw a card at random. If yours is picked, you'll receive a one-year subscription (or extension) to 73. If you use your QSL card for your critique, we'll consider it also part of our QSL contest.

To save on postage why not send your card in an envelope with a damning or praising letter to the editor while you're at it too.

Send to "Feedback" at 73 Magazine, 70 Route 202 North, Peterborough, NH 03458.

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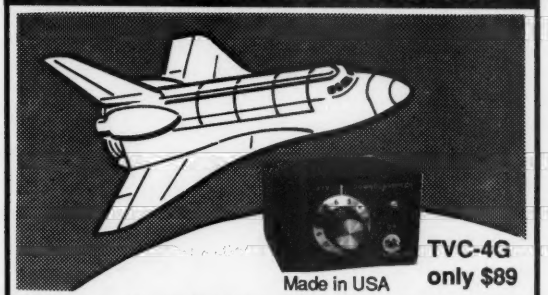

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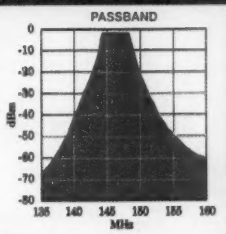

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Satellites, Weather Imagery, and Sunrayce '95

There's an Indiana Jones in each of us.

James R. Buchanan K8WPI
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Kalamazoo MI 49004

Anyone can have an adventure. All you need is a little willingness and a special skill or two. Then, be ready when fate drops an opportunity on you.

Winter 1987: The Seed Is Planted

The north winter wind was covering the woodpile with snow as I slogged back to the house with another load of logs for the fire. Entering the house and shedding a dozen layers of clothes, I opened the door to the wood stove to feed the flames of warmth. As the fire glowed through the glass door of the stove, the image on the TV screen was almost as bright. Minuscule cars, not much more than oversized skateboards, powered only by the sun, were winding their way across Australia from Darwin to Adelaide. A PBS special on the first World Solar Challenge caught my attention. I sat there spellbound for the next hour. This was the adventure of a lifetime. Twentieth-century Magellans, Byrds and Huck Finns were embarking on a technological revolution while sharing an adventure that dreams are made of.

The first World Solar Challenge caught my attention with a passion. I knew then that if I ever had the opportunity to become involved with such an event, I would jump at the chance, whatever the cost or consequences might be.

Fall 1992: Germination

The September meeting of the Kalamazoo Amateur Radio Club started with the obligatory business meeting, laden with the excitement of the August minutes and the treasurer's report. As the evening droned on, I began to fade from focus when I thought I saw Rod Sterling stand up at the chairman's table. A familiar voice announced that Western Michigan University was looking for a communication specialist, and was interested in investigating weather reconnaissance for Sunrayce '93 next summer. What? Was this the chance for me to don Indy's fedora and head off into the sunset in search of the solar grail? It took about two nanoseconds to know this was what I was looking for. I would make the commitment for myself and my wife, right there on the spot. I approached Rod (actually J. C. Schneider KF8TJ, a neighbor of Dick Schubert, the father of WMU's solar racing project) and advised him to have the WMU folks get in touch with me; I'd see their needs were met!

I spent the fall and winter of '92 reading every book written on anything related to watching the Earth from space and weather services in the RF spectrum. I started planning the ultimate mobile weather reconnaissance vehicle. By June, I was on the road with the most sophisticated, privately owned original-source solar reconnaissance vehicle on earth, as far as I knew.

Bearing Fruit

After successfully completing Sunrayce '93 from Dallas to Minneapolis with WMU, I was approached by a dozen hopeful schools about providing similar weather imagery and data for Sunrayce '95.

Sunrayce is a biennial event hosted by the Department of Energy, General Motors, National Renewable Energy Lab, and a dozen other automotive-related industries. The concept is to promote the technologies and growth of solar power. Universities, colleges, technical schools, and even community colleges from the US, Canada, Mexico, and Puerto Rico design, build, and race solar-powered vehicles across the country. The cars must meet minimum highway safety standards. Battery storage and solar collector maximum specifications are set by the race committee. The cars must be powered 100% from the sun. Excess energy collected from the solar array may be stored in batteries for use at a later time. For the most part, the race course is primary and secondary highways; little time is spent on the expressways.

There is a charging period each morning, this year from 6:00 a.m. to race start at 10:00 a.m. local time. The cars leave the starting line in the order of finishing the previous day's run, or in their qualifying position the first day. Cars are started in one-minute intervals, to spread them out over the course a bit. A mandatory midday stop provides the opportunity to change drivers, make minor

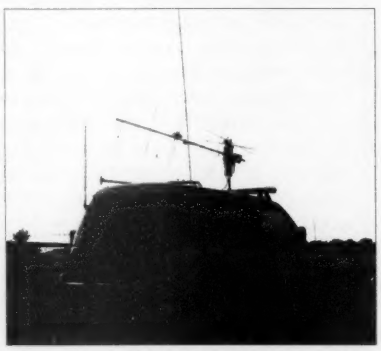

***Photo A.** "MONDO-MITSU" mobile antenna farm, Fort Smith, KS.*

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Every feature can be mastered in minutes. No modern rig is as easy to use. It only takes a second to change bands. Plug-in modules are available for 160-10 meters including WARC. Single conversion and crystal mixing are the foundation of this 90 dB dynamic range receiver. That's the strong signal performance of rigs costing 3 times as much! It's sensitive and receive audio is sparkling clean with less than 2% distortion. The ideal selectivity for every band condition is at the touch of a knob. This patented "Jones" filter provides variable I-F bandwidth from 500 Hz to 2.5 KHz.

HERE'S HOW IT'S USED

MOBILE

Hams complain about today's cars having precious little space for gear. The SCOUT is the smallest HF rig in the industry (excluding QRP) measuring only 2.5" x 7.25" x 9.75" and runs directly off the 12 VDC car battery. If the SCOUT won't fit your car, nothing will. The optional noise blanker reduces ignition noise from both your car and the one that just drove by.

PORTABLE

Business travelers and vacationing hams typically set up a briefcase or small travel bag to include the 5 lb SCOUT, wire or whip antenna and lightweight power supply like our Model 938 switcher (its only 3 lbs!). It is surprising how many hikers and cyclists take along their SCOUT using some clever battery arrangement.

NEW HAMS

The SCOUT is the most economical way to get started in ham radio. Consider the choice a new ham must make just to test his interest in HF: (1) Spend nearly $1000 or more on a new rig, (2) buy a used radio and take a chance on its condition, or (3) invest in a SCOUT at $549 with a one year factory warranty and our legendary TEN-TEC support.

OLD TIMERS

Operators with years of experience and a shack full of expensive HF gear also buy the SCOUT. It's refreshing to many who say "It takes 5 minutes to learn and without all the complicated features, there is only one thing to do with a SCOUT, work someone!" Experienced hams call us constantly to report "I can't believe this receiver, it outperforms my $1400 synthesized rig".

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repairs, and to make a personal pit stop. This 15-minute stop is "off the clock," so all cars leave the midday stop in the order they arrived. A common end of day location is the finish line for each day. Charging is allowed until 9:00 p.m., when the cars are impounded overnight. The lowest elapsed time for the day's route establishes the day's winner, with the overall race winner being the team with the lowest accumulated time over the course of the race. This year's race was from Indianapolis, Indiana, to Golden, Colorado, just over 1,100 miles.

Each team has a lead and chase vehicle, and the solar car is "cradled" between these two buffers. With at least a three-car entourage for each car, passing can be a real challenge, but safety is paramount. Solar cars, with electrical consumption of less than a blow dryer, are fairly fragile. A broadside collision would almost certainly be fatal. The lead and chase vehicles provide higher visibility for the diminutive racers on rural country roads. The pace is determined by the strategists in the support vehicles; the race car driver is to keep the car on the road, drive as smoothly as possible, and follow instructions fed by teammates via radio. Each team is accompanied by an "official observer," provided by the sponsors, who makes sure the team follows all applicable traffic laws. Infractions are met with penalties, representing time added to the actual drive time each day.

Photo B. *Inside view of the operating position in the back seat. Note power monitor control panel at bottom, keyboard drawer for storage while in motion, and printer on top of rack.*

With limited energy, a fixed schedule, tremendous competition, and years of work riding on the performance of each team, no one takes the race casually. Some schools have teams approaching 100 people in all aspects of the project, and may spend hundreds of thousands of dollars in design, preparation, and execution of the race. With such great stakes, every advantage available is considered and used, if possible.

As the total power requirements for the race car must come from the sun, the weather plays a very important role in how strategy is applied and how the day's course is run. Today and tomorrow's weather will affect the collection capabilities of the array. The daily course, whether hilly, flat, gradual incline, or steep slope, will determine the energy consumption of the car. Small towns with intersections, traffic lights, and railroad crossings all eat into your available energy supply. If you decide to pass another car to advance your position, you must weigh the gains versus the loss in energy. You must know not only how much energy you have stored, but how much you are currently using, what you expect to gain at the end of day, charging time, and what your use and charge rates will be tomorrow.

Weather Reconnaissance and Strategy

My participation was to provide onsite, real-time weather information and imagery. Although as a support vehicle I was required to drive an alternate route, radio contact and midday rendezvous enabled us to exchange the required information.

My Mitsubishi Montero, named "Mondo," was equipped to gather as much information as practical, although I have been told I was far beyond practical. The polar orbital U.S. NOAA and Russian MET series satellites operating on 137 MHz offer very detailed information on a fairly steady basis. With four American and two Russian satellites providing images, the selection would be great. I would also use terrestrial-based charts, graphs, and rebroadcast images from the GOES satellites.

For Sunrayce '93, the equipment rack in the back seat of Mondo held an HF ham band transceiver, general coverage receiver, antenna tuner, FM fax demodulator, VHF satellite receiver, satellite demodulator, computer, RGB-to-NTSC video converter, video monitor, high resolution large format video printer, 8mm taperecorder, plain paper printer, GPS receiver, and work lights. The antenna complement was the external GPS antenna, 144/440/900 amateur band/cellular antenna, 160–10 meter amateur band antenna, 150 MHz business band vertical, and a collapsible turnstile antenna for the APT satellites, similar to the "Zapper" as described in Ralph Taggart's *Weather Satellite Handbook.* This antenna was built on the principle of a blind person's cane, held together internally with elastic straps. The antenna would collapse to about 4" in diameter and 3' in length. A good "shake" and the antenna would snap into position. I would then place it in a boot atop the car and catch the satellite passes. This allowed me to run up and down the road without a satellite antenna on the car. It kept the competition guessing about what I was doing, as there were no telltale signs. Although the Zapper worked, it was less than impressive, at least by my standards. The team was happy, we had usable images, excellent weather prediction information, and that was that!

Mobile Imagery

As the months after Sunrayce '93 wore on, I became more interested in the possibilities of mobile imagery. I already knew I was going on Sunrayce '95, I just didn't know with whom, yet. I started to investigate the possibilities, while making preparations for Polarquest-'94 (don't ask and I won't have to tell you, but suffice it to say it had to do with the North Pole).

For serious APT images, especially the lower-angle passes which provide more east/west information, I needed more of an antenna. I also needed to get rid of more noise generated from equipment within Mondo.

Woodhouse Communication provided me with the answer, a circularly polarized yagi made especially for the 137 MHz band. Available in a rear-mount configuration, it was ideal for mobile installation as it eliminates the large vertical turning radius needed for "over-the-top" passes. The idea of a yagi mounted on a vehicle may seem a bit like overkill, but let me share with you

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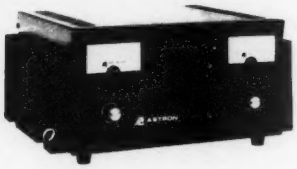

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SL-11A	•	•	7	11	2⅝ × 7⅝ × 9¾	12
SL-11R	•	•	7	11	2⅝ × 7 × 9¾	12
SL-11S	•	•	7	11	2⅝ × 7⅝ × 9¾	12
SL-11R-RA		•	7	11	4¾ × 7 × 9¾	13

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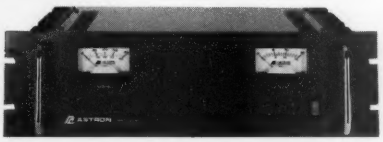
MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
RS-4L	3	4	3½ × 6⅛ × 7¼	6
RS-5L	4	5	3½ × 6⅛ × 7¼	7

RM SERIES



MODEL RM-35M

- 19" RACK MOUNT POWER SUPPLIES

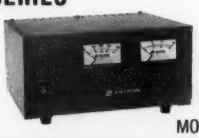
MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
RM-12A	9	12	5¼ × 19 × 8¼	16
RM-35A	25	35	5¼ × 19 × 12½	38
RM-50A	37	50	5¼ × 19 × 12½	50
RM-60A	50	55	7 × 19 × 12½	60
• Separate Volt and Amp Meters				
RM-12M	9	12	5¼ × 19 × 8¼	16
RM-35M	25	35	5¼ × 19 × 12½	38
RM-50M	37	50	5¼ × 19 × 12½	50
RM-60M	50	55	7 × 19 × 12½	60

RS-A SERIES

MODEL RS-7A

MODEL	Colors Gray	Colors Black	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
RS-3A		•	2.5	3	3 × 4¾ × 5¾	4
RS-4A	•	•	3	4	3¾ × 6½ × 9	5
RS-5A		•	4	5	3½ × 6⅛ × 7¼	7
RS-7A	•	•	5	7	3¾ × 6½ × 9	9
RS-7B	•	•	5	7	4 × 7½ × 10¾	10
RS-10A	•	•	7.5	10	4 × 7½ × 10¾	11
RS-12A	•	•	9	12	4½ × 8 × 9	13
RS-12B		•	9	12	4 × 7½ × 10¾	13
RS-20A	•	•	16	20	5 × 9 × 10½	18
RS-35A	•	•	25	35	5 × 11 × 11	27
RS-50A	•		37	50	6 × 13¾ × 11	46
RS-70A	•		57	70	6 × 13¾ × 12⅛	48

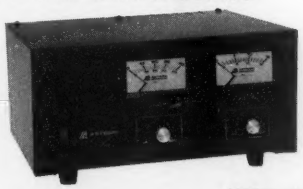
RS-M SERIES



MODEL RS-35M

MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
• Switchable volt and Amp meter				
RS-12M	9	12	4½ × 8 × 9	13
• Separate volt and Amp meters				
RS-20M	16	20	5 × 9 × 10½	18
RS-35M	25	35	5 × 11 × 11	27
RS-50M	37	50	6 × 13¾ × 11	46
RS-70M	57	70	6 × 13¾ × 12⅛	48

VS-M AND VRM-M SERIES



MODEL VS-35M

- Separate Volt and Amp Meters • Output Voltage adjustable from 2-15 volts • Current limit adjustable from 1.5 amps to Full Load

MODEL	Continuous Duty (Amps) @13.8VDC	@10VDC	@5VDC	ICS* (Amps) @13.8V	Size (IN) H × W × D	Shipping Wt. (lbs.)
VS-12M	9	5	2	12	4½ × 8 × 9	13
VS-20M	16	9	4	20	5 × 9 × 10½	20
VS-35M	25	15	7	35	5 × 11 × 11	29
VS-50M	37	22	10	50	6 × 13¾ × 11	46
• Variable rack mount power supplies						
VRM-35M	25	15	7	35	5¼ × 19 × 12½	38
VRM-50M	37	22	10	50	5¼ × 19 × 12½	50

RS-S SERIES

MODEL RS-12S

- Built in speaker

MODEL	Colors Gray	Colors Black	Continuous Duty (Amps)	ICS* Amps	Size (IN) H × W × D	Shipping Wt. (lbs.)
RS-7S	•	•	5	7	4 × 7½ × 10¾	10
RS-10S	•	•	7.5	10	4 × 7½ × 10¾	12
RS-12S	•	•	9	12	4½ × 8 × 9	13
RS-20S	•	•	16	20	5 × 9 × 10½	18
SL-11S	•	•	7	11	2¾ x 7⅝ x 9¾	12

*ICS—Intermittent Communication Service (50% Duty Cycle 5min. on 5 min. off)

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the essence of what I have learned over the past three years of mobile and fixed location imagery.

Nobody Knows the Noise I've Seen

There is nothing that can kill the quality of an image like noise! As if some deity out there just doesn't want us to mess around with APT satellites, every conceivable obstacle has been built into the system. Just look at the receiver bandwidth required for APT images. Forty kilohertz lets in a lot of noise. Sure, you can easily copy a signal of 1/2 microvolt on your 2 meter handheld, but you only have a 5 kHz bandwidth. The wide bandwidth, and the fact that 1/2 microvolt is more signal than frequently available for your satellite receiver, presents a challenge. Throw in the numerous high power front-end overload sources near the frequencies, and you need all of the help you can get. No, this is not rocket science, but LEO satellite reception at home is an entirely different world than from your car or van. Noise comes from all sorts of sources. I don't know what the criteria for meeting FCC Part B radiation is, but evidently it is just short of nuclear impulse.

The computer used to display the image, or to control the tracking system is the largest source of noise, yes, even up to 137 MHz! I have spent hours hand-selecting individual boards for use within the computer, substituting different brands of the same type of board, searching for the quietest one. There are significant differences. All input/output lines are decoupled with ferrite beads. The video monitor is another great source of noise. The more sophisticated the display, the greater the noise. This year I needed ESVGA to provide 1024 X 756 X 256 resolution. Big-time display, big-time noise! My demodulator has been tweaked like an Indy race engine, and additional decoupling and shielding has been added to the point where the manufacturer's original cabinet is only an outer shell, covering the added interior shielding. All power supply lines are shielded and decoupled. If you are afraid of diving into your expensive commercial equipment for which you don't have a schematic, this may not be the "motor sport" for you. Many pieces of equipment have feedthrough networks added to their power lines. All cables are insulated to prevent ground loops. Cables within the rack are separated by function to provide additional isolation, and some cables are actually laced into the position which radiates the lowest amount of noise. Power distribution using shielded wire is routed via separate circuits with individual circuit breakers for different functions. Each piece of equipment is bonded via an individual ground wire to the common rack/chassis ground. Remember, a good DC ground probably isn't very good at 137 MHz.

***Photo C.** D-Day -2, final preparations done, ready to hit the road.*

If you use a desktop computer, you need 110 VAC for power. Power inverters are a whole new breed of noise generators. I have found the new high-tech class D switching supplies will generate noise from 60 Hz to over 400 MHz. Even the HF ham bands become worthless with the buzzing drone of this type of inverter. Maybe there is a quiet one out there; however, I have tried five different inverters, all with the same results. The inverter I use is an antique bi-stable multivibrator type with a real E-I core transformer which goes a long way to limit its spread-spectrum capabilities. I never was successful in eliminating the rampant microprocessor noise in my new all-band all-mode HF transceiver; I just turned it off while catching passes. The only pieces of equipment which have not caused external noise radiation are the Vanguard WEPIX 2000B receivers, the AEA FAX, the KAM TNC and the previously used TS-820 and FRG-8800. With three major outings over the past three years, I have spent hundreds of hours determining noise sources, and eliminating them. If I can be of any assistance to you in similar endeavors, I hope it will be in preparing you for the challenge at hand, giving you some clues as to where to look for noise, and what may need to be done.

The problem is always the proximity of the noise source to the antenna. I have measured noise reduction of 40 dB, enough to eliminate the problem, just by moving the antennas 20' away from the car. Unfortunately, that is not a practical solution for these events. Your antenna will be within a few feet of the noise sources, so you must keep your nose to the grindstone.

Practice Makes Perfect

My planning for Sunrayce '95 started in April 1994, after making a commitment to Queen's University of Kingston, Ontario, Canada. There were a few "givens" to be reckoned with. The sunspot cycle would be at the bottom of the curve in June 1995. This means HF communication would be the worst it could be. As HF signals from numerous sources are absolute essentials, the HF equipment and antenna would have to be upgraded, and offer the highest performance available. I purchased a new FT-900 HF transceiver to replace both the old transceiver and the general coverage receiver. This saved a lot of space, reduced power consumption, and offered tremendous flexibility. The SGC-QMS antenna was selected as the HF antenna of choice. This superperformer provides complete coverage from 1.8 to 30 MHz. This would allow peak performance on the ham bands, as well as general coverage receiving. Always preparing for the worst, I packed a wind-up longwire. The "SMART-TUNER" in the QMS can tune

***Photo D.** Almost 4,000 later, on the triumphant return through the Badlands.*

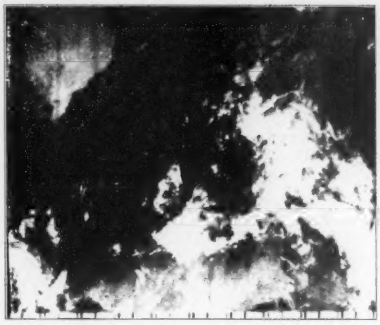

***Photo E.** NOAA satellite image showing the well-defined "V" cloud formation of a severe thunderstorm, just ahead on the race course.*

an end-fed wire if more antenna is needed due to poor conditions. The VHF antennas would also need to be improved. Although I did my best to keep my activities quiet during Sunrayce '93, people figured out what I was doing, and I knew the competition would be inspired from Mondo '93. I would have to assume teams would try to emulate my efforts; I had to be at least a generation ahead of them. The APT-4X4RM I used on Polarquest was remarkable. At that time, I manually tracked the satellites. This year, I would use the computer for auto-tracking. I did not hesitate to install the APT-4X4RMX yagi and the APT2CP turnstile from Woodhouse. Keep in mind, putting full-sized VHF antennas on a car and running them down the road up to 10 hours a day, even in the rain and hail, requires extremely tough antennas. Weatherproofing is also important. A gentle shower on your roof becomes a gale force storm at 65 MPH! The possibility of full days of rain must be considered a reality. The antennas must perform, regardless!

The new equipment rack layout was started in December, with preliminary tests made as soon as the weather was decent. Being one of those Midwestern conservatives, I don't trust to luck, I trust to knowledge. The equipment rack and antennas were permanently installed on Mondo in April, which allowed two full months of fine-tuning, practicing, and preparing for any scenario.

On the Road

My team advised me about a month before the race that they had made arrangements for a professional meteorologist to accompany me. He would be bringing a small dish for data acquisition. *Wow!* Now this was really getting interesting.

Pam (my wife) and I arrived in Indianapolis on Saturday afternoon; the race started Tuesday. On the way to Indy, we continued "practicing" by capturing near overhead passes (###25) while on the move. After a casual look around at the solar cars, and a brief meeting with our team captain, we were introduced to Etienne Gregoire, the meteorologist supplied to the team by Environment Canada. ET, as he is called, is one of those people you like right off the bat. A mild manner, a good sense of humor, and an inquisitive mind made this look like a good relationship. Considering the time we were to spend together over the next 1,100 miles, and the work schedule that would develop, I was very pleased we drew ET from the pile.

"Applying our APT-gained information to the computer modeling gave us the truth."

ET came equipped with a 1.7 meter dish, a receiver, a computer, and 15 years' experience as a professional meteorologist. ET and I shared information on what was available from each other's services. From the ANIK E satellite, ET was able to pull all weather maps available from Environment Canada. We had regional radar summaries, computer models, cloud cover statistics, weather forecasts, observations from both private and public agencies, and custom-plotted solar insulation factors for the race route. I had all products from NAM/NMC, plus the polar orbitals. Just prior to the race, NOAA 9 was turned off for reasons unknown. NOAA 10 had been off a few months, due to course collision with NOAA 12. Of course, the Russians turned off MET 3-4, so we were left with three satellites for the duration. Marginal, but we could make it!

We compared time schedules for weather products, reviewed the daily schedule for the race and estimated our future locations for collection of products. We put together a plan for the next nine days and hoped for the best. I made a preliminary list of every NOAA and MET orbit during the race. I used Auto Map to roughly determine the long./lat. coordinates of locations along the route, and assigned reasonable time frames for our progress. This provided a list of possibilities, based on where we would be at any given time. The list was kept available for reference, but a second list was made of the required passes. This list was then integrated with my daily "activity schedule" and printed. The daily schedule was a list of activities I needed to perform, based on time and date. The day was spent checking off events as they occurred. Although near overhead orbital passes might be caught free-hand on the APT2CP, the longer passes which required tracking necessitated finding a suitable place to park Mondo, facing north, and determining our current position using GAPS. The exact coordinates were then entered into the tracking program.

The data ET was receiving would be used in conjunction with the images from the orbitals and additional charts from NAM/NMC. I was very pleased to hear from ET that the quality of the images I was gathering on the road were better than those available back at the office. As ET said, we know a front is going to move, we just don't know when, or how fast. Computer modeling will move the front based on many factors, all conjecture. We were able to view the front three times a day, and therefore knew exactly how fast, and in which direction, it was moving. Applying our APT-gained information to the computer modeling gave us the truth. We relied heavily on 72-hour predictions from HF sources, and reviewed the GOES images twice daily.

Any Good Boy Scout Is Well Prepared

I used the MultiFax demodulator and software for day-to-day use. As expected, the grid/mapping capabilities would come in handy. Reviewing the race course before leaving Kalamazoo, it became painfully obvious we could have some real "Where are we?" problems. The lack of geographic landmarks through the plains states coupled with the likelihood of fairly dense cloud cover would severely hinder our efforts. I took an hour or so and put together a "grid-map locator" database using every conceivable landmark that could be seen and identified from space.

Only two days into the race, we were cloud-covered! The team wanted to know "What's out there?" Reviewing a morning NOAA pass, I found two

landmarks for the map overlay. Would you believe the only landmarks I could find were the Great Salt Lake and the Door Peninsula of Wisconsin? Well, it worked! The map overlay allowed us to determine where in the clouds we were, and therefore to determine where and when our solar car could expect to find sunshine. This feature was used three times during the race, and was crucial to our success.

Another advantage we had was the extremely high quality images. We could capture the near overhead passes with the APT2CP, which is a story in itself. Briefly, I couldn't provide the clearance necessary for a complete antenna, so I used the roof of the car as a non-resonant reflector. The performance of the antenna was noticeably reduced, but I had been practicing and fine-tuning the entire system for the previous two months and knew the limitations. The APT-4X4RMX yagi coupled with the Yaesu AZ/EL rotor would allow us to reach out for the long passes. The 4X4 antenna provided incredible images, on passes as low as 9 maximum elevation; not bad for mobile! That meant we could get distant early morning passes to get an early look at the day, and look ahead to the west a long way on later passes. We could use passes not available to an omnidirectional antenna. This literally doubled the number of usable passes available to us. The directionality of the yagi was also a significant contributor to reduction of noise pickup from devices within Mondo.

Although I assume no credit for weather forecasting, we had all of the information needed, and ET was very skilled. We had no surprises; the weather happened just as predicted, when predicted. Over 4,500 miles were logged for Sunrayce '95, and another 1,500 miles were put on the equipment during preparation testing before the race. Everything worked well, with no problems.

Other Satellite Applications

I wasn't the only one using GPS on Sunrayce. Hughes was one of the major contributors for the event, and provided an interesting application of the telpath navigation system. The telpath system was developed for in-car use. A GPS receiver and a computerized map database and display will allow a driver to see where he is within a city. This can help guide the driver to the desired destination.

For Sunrayce, the application was to provide a GPS receiver for each vehicle team, connected to their cellular phone. The map display was the day's route, and the display(s) was (were) at the start/end of day and at the midday stop. You could approach a monitor and see the location of each car on the race course. This was a novel approach to provide the hordes of visitors a clue as to where their favorite car was.

Driving by the S-Meter

The first day was a short course, from Indianapolis to Terre Haute. After a glorious start at the War Memorial and Capitol building, with a rousing series of speeches and well-wishes from the Mayor and the Secretary of Transportation, the cars were off. We headed out of town toward Terre Haute. ET requested a chart from NAM in Norfolk.

Well, as expected, propagation was terrible, and by then it was about 1500 UTC. The morning propagation from NAM had shifted; we were somewhere between the short and long hops, if there were actually any hops at all. We were cruising down the highway, desperately seeking NAM on all frequencies programmed into memories on the HF rig. We didn't have time to stop; we had to get this one on the fly. I lit a cigar in frustration, while keeping my ear to the radio and one finger depressing the scan switch on the microphone, I noticed an 18-wheeler approaching in my side mirror. "Oh great!" I exclaimed. "Just what I need, the biggest shadow on the road and I have less than S-1 signal to begin with."

The rig slipped past me and as he started to pull back into the driving lane, the S-meter jumped. "Yes!" The perfect reflector for my antenna was now directly in front of me, and we were driving exactly opposite Norfolk. I asked Pam to check the map and see if this road would be straight for the next 25 miles. Upon confirmation that the road should be good, I began closing the distance between us and the large rear end of the trailer. I kept an eye on the S-meter, and sure enough, when we were about two wavelengths behind the rig, the S-meter jumped to about S-4. Good enough! I kept one eye on the S-meter, and one eye on the semi in front. I wanted to keep the signal as strong as possible, but even at 3 MHz, we were very close to a very large bumper! I believe Pam rested her eyes for the next half hour, and when I slowed down to back off from the trailer, she squinted into the back seat to view the monitor. "Well, you got it; I hope you're happy."

Amateur Spotters along the Way

From Indianapolis to Aurora, Colorado, teams of amateur radio operators provided spotting for the officials. Check points were set up along the route, and as each car passed, the time and car number were noted and passed

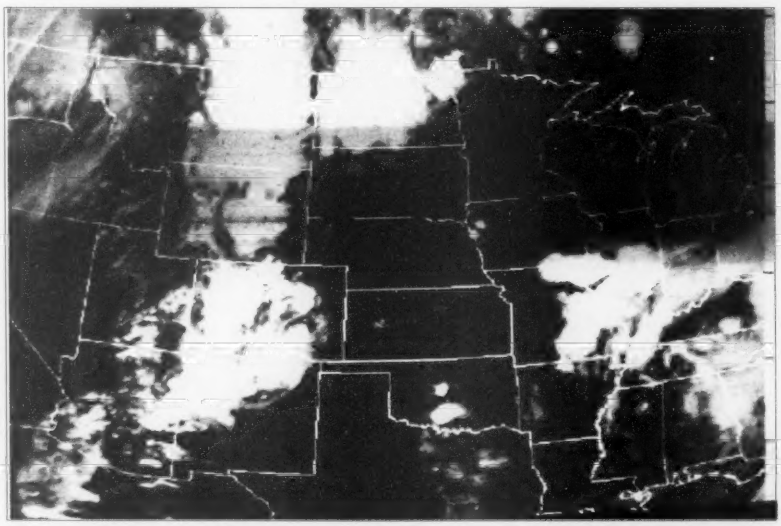

Photo F. *Map overlay on NOAA image taken at Alton, IL. The overlay enabled us to determine the edge of the storm and hope for the rest of the day. The large front over the Rockies is beginning to move.*

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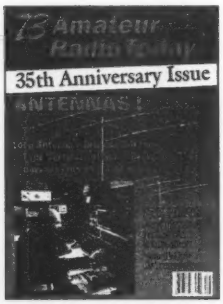

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on. This was very beneficial in locating cars which might be suffering mechanical problems, and in keeping an overall eye on the progress.

Bennett Basore W5ZTN spearheaded this effort, as he did in '93. Bennett deserves some kind of sainthood award for his efforts and patience. Along the road we encountered every level of amateur, communication ability, and obstacle. Even though we frequently stretched the capabilities of local systems, and there seemed to be some deficiencies in preparation, every individual, club, and organization must be commended for their efforts. To achieve cross-country coverage during the week, many people took time off from work to be able to man the radios. I know there were many inconveniences faced by all involved, and the spotting locations were always less than where you would like to spend four or five hours!

Although Denver was not able to provide radio communication the last day of the race, the Denver area ATV group went all out and provided images from two camera locations to the end-of-race finish line. It was raining all day, and it was cold! Not only a miserable end for a solar event, but nothing short of hazard duty for the camera operators who stood by their cameras, providing continuously framed and focused images as cars approached the finish line.

QRX While I Reload

What's next? Hopefully by the time you read this, I'll be preparing to cruise across the Outback of Australia with the World Solar Challenge. The WSC is the other big event in solar-powered vehicles. This event is more demanding than Sunrayce, as the course is much longer and almost no one feels as if they are "at home." At the time of writing this article, I have a tentative invitation. For now, I am preparing, learning as much about the land down under as I can, and dreaming of tracking satellites upside down.

For more information; contact the author or review the following references on related subjects.

Useful Books

Weather Satellite Handbook; Ralph Taggart. ARRL.

The Weather Satellite Experimenter's Handbook; Martin Davidoff. ARRL.

Weather Radio. Anthony Curtis. Tiare Publications.

Space Satellite Handbook; Anthony Curtis. Gulf Publishing.

Exploring the Environment Through Satellite Imagery; Dr. Ann Berman. Tri-Space.

Guide to Utility Stations; Klingenfuss. Klingenfuss Publications.

Guide To Facsimile Stations; Klingenfuss. Klingenfuss Publications. 73

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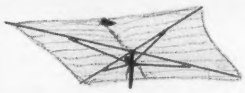

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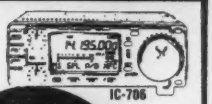

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Souping Up a Surplus Field Strength Meter

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An interesting piece of surplus test equipment that has been showing up lately is the ME-61/GRC field strength meter. I've seen them at both Dayton and the Dallas HAMCOM. These ME-61/GRC field strength meters have all been in sealed cardboard cartons (i.e. they are all unused). Prices seem to range from $15 to $25.

What is the ME-61/GRC? It is a tunable field strength meter "for use with such tactical radio systems as Radio Sets AN/GRC-9, AN/GRC-87, and AN/VRC-34," whatever those are. The instruction manual that came with my unit was dated 1966, so these are probably Vietnam War era products. It is interesting to read the instruction book section titled "Demolition to prevent enemy use" which, incidentally, comes right after the alignment and troubleshooting section.

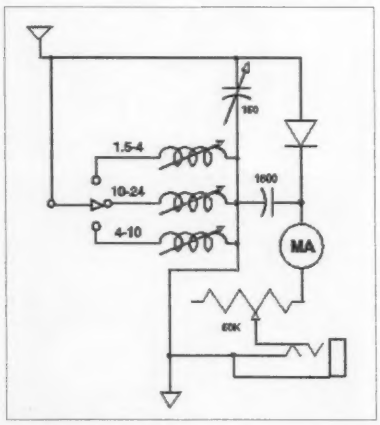


Fig. 1. *Original circuit.*

Photo A. *The ME-61/GRC field strength meter with the SO-239 connector.*

ME-61 FSM Description

The ME-61 FSM comes in a very nice military green watertight enclosure which includes a telescoping whip antenna and covers 1.5 to 24 MHz in three calibrated ranges: 1.5–4 MHz, 4–10 MHz, and 10–24 MHz (160 through 15 meters). As shown in Figure 1, the schematic, the ME-61 FSM covers these three ranges by switching in different inductors. The variable capacitor is common to all three ranges. A second bandswitch position (not shown on the schematic) also shorts out the unused inductors so that there is no mutual coupling between the used and unused inductors. The resulting parallel-tuned circuit feeds a simple diode detector and then a 1 milliamp meter through a 50k ohm variable pot. Headphones can be plugged into the phone jack for detecting AM signals. The ME-61 FSM works well; however, it is not that sensitive—due primarily to the 1 milliamp meter that the detector circuitry has to drive.

Modifications

There are typically two problems with the ME-61 FSM: The internal pull-up telescoping antenna corrodes easily, and the lack of sensitivity, as mentioned earlier.

My ME-61 FSM was similar to others that I had seen in that its antenna was corroded. I addressed this problem by completely removing the antenna and mount from the front panel. The hole that remains is just slightly larger than that required by an SO-239 UHF connector. Therefore, I centered an SO-239 on the hole and carefully marked locations for two mounting screws. After drilling #4 holes in the front panel, I mounted the SO-239 from the inside of the front panel. This looks good (see Photo A). For the antenna, I used a Radio

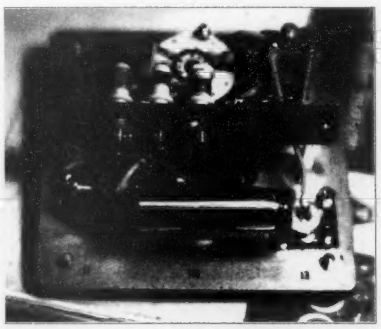


Photo B. *The inside of the ME-61, showing the battery hot-glued to the meter.*

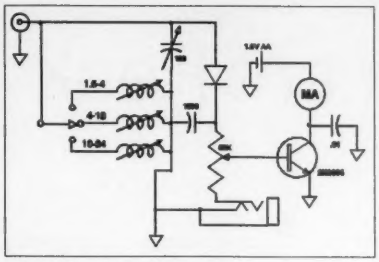


Fig. 2. New circuit.

Shack 270-1409 six-section cordless phone replacement antenna ($3.49) soldered to a banana plug (RS 274-721). The banana plug plugs into the center hole of the SO-239, and the collapsed antenna easily fits inside the cover of the box.

Now for the sensitivity improvement. As you can see from Figure 2, I simply rewired the metering circuitry and added a 2N3904 NPN transistor as a current amplifier (almost any NPN transistor can be used). I also changed the detector diode to a 1N34 germanium diode (RS 276-1123). The 1.5V AA battery is mounted in a plastic battery holder (RS 270-401) which has been hot-glued to the meter (see Photo B). You'll note that there is no on/off switch. With no signal input, the transistor can't turn on and therefore no current is drawn from the battery.

Results

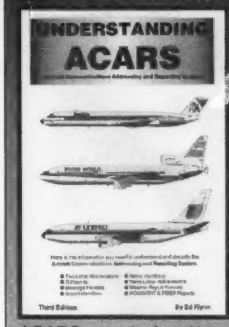
The sensitivity improvement is significant. Before the modification, I could get no more than a half-scale reading at maximum sensitivity when I was located approximately 100 feet from my mobile antenna, running 100 watts output power. After the modification, I can get a full-scale meter reading at 100 feet with only 10 watts of output power, with less than full sensitivity!

Conclusion

If you would like a frequency-selective field strength meter, keep your eye out for the ME-61. The simple modifications described here can really turn the ME-61 into a valuable piece of test equipment. Other modifications can enhance the ME-61 even further. As an example, you might want to turn the 1.5–4 MHz range into a 15–40 MHz range if the higher frequencies are more interesting to you. Also, it is better to have an RF preamp ahead of the detector than a DC amplifier after it. You could replace the 50k pot with a combination 50k pot and switch for powering the RF preamp. Or maybe you could use the phone jack hole for something since most folks don't use AM detectors anymore. Experiment and have fun! 73

UNDERSTANDING ACARS

Aircraft Communications Addressing and Reporting System



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Microwaving on Monument Peak

The story behind our cover photo.

C.L. Houghton WB6IGP
San Diego Microwave Group
6345 Badger Lake Ave.
San Diego CA 92119

I took the cover photo on top of Monument Peak (DM12SV) in the Laguna Mountain area of Southern California. This location is about 50 miles east of San Diego at an elevation of 6,300 feet. This operation was part of the ARRL 10 GHz contest in September 1991. 10 GHz contacts were to be attempted between the San Diego Microwave Group and a group of amateurs operating from Mount Union (DM34TK) at a 7,700-foot location near Montezuma Castle National Monument in central Arizona.

The photograph shows a portion of Monument Peak—real billy-goat territory—and our stations on top of a small pile of rocks, to which the two stations were anchored. Several bungie cords and cables were used to tie the equipment firmly to the rocks to keep them upright in the heavy winds. Kerry N6IZW is pictured on part of the rocks (our chair) just below his dish antenna and 10 GHz equipment during this memorable contact. The tower to the right is part of several commercial installations sharing this mountaintop location.

Our microwave shot is not a record distance, but consider that this path was obscured by several other mountains, making this attempt a tough challenge. The plan agreed upon was for the Arizona station to transmit during every even 10-minute period, and our station to transmit on odd 10-minute segments in case the lower frequency liaison could not be established. Ultimately, 2 meter SSB contacts were made. After some 30 minutes of antenna orientation and frequency scanning, both Kerry N6IZW and Chuck WB6IGP made contact with Dave KY7B within a minute of each other.

Signals were not strong initially but did increase to allow operation from all of our group members that day. Part of the reason that Kerry and I made contact first was that we both use similar equipment and 10 watts of power feeding a 30-inch dish antenna. Consider that our 10 watts of power and KY7B's 28 watts both feed high gain microwave dish antennas (34 dB gain), the product of which produces quite a high ERP power level. This gave us quite an edge when signals were marginal. As time elapsed, signals increased to S-2 for short periods of time.

Ed W6OYJ, John WB6BKR, and Jerry WA6VLF made contacts with two of the stations, operating with only 100 milliwatts. Signal conditions fluctuated, rapidly producing severe Doppler frequency shifts on SSB voice. Voice could be best described as a good Halloween ghost voice imitation due to multiple reflections and cloud scatter. We speculate this was partly due to reported heavy rain near our midpath calculations. Signals peaked quite high for a few moments and we suspect we were reflecting off aircraft flying through the same area. The biggest regret of this whole contact was that we had all forgotten our tape recorders for capturing the cloud scatter audio contact, useful for future brag sessions. 73

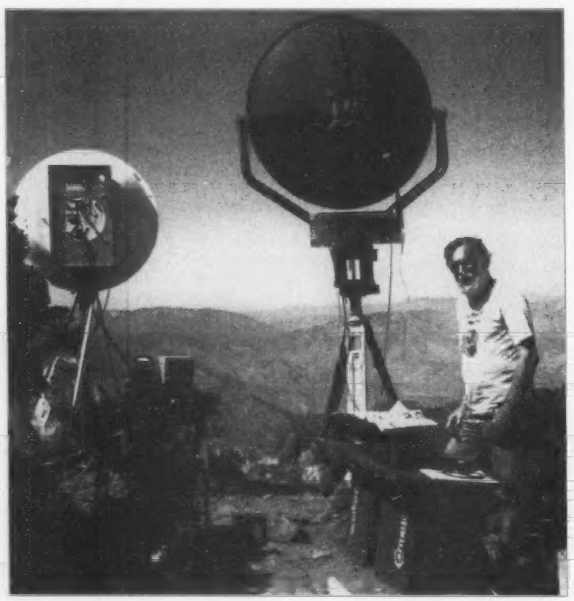


Photo A. *Microwave operation in the San Diego mountains at an elevation of 6,000 feet above sea level. Making contact over the distant mountains required antenna alignment to be accurate within 1 or 2 degrees on the compass. Just beyond this vantage point, the mountain drops off 5,000 feet to the desert floor.*

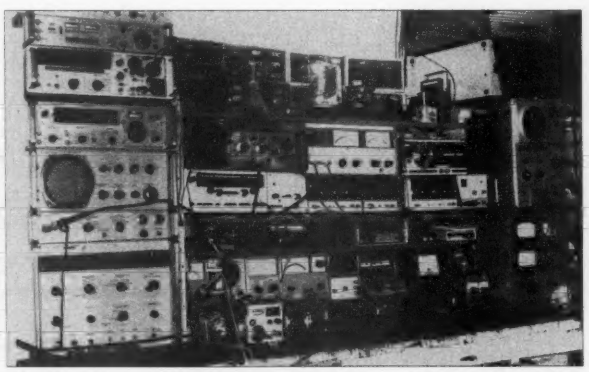


Photo B. *The test workbench at WB6IGP. It's equipped with spectrum analyzers, sweepers, signal generators, vector voltmeters, scope and plain old VOM and solderings— a lot of junk that the power company would be proud of if I turned it all on at one time! This is where most projects get the final test.*

A Mobile Power Panel

Protect your vehicle and your rig.

Tony Marchese, N2YMW
35 Shannon Crescent
Spencerport NY 14559-9758

I recently obtained a 2 meter radio for my car. After consulting several sources, I was convinced that a direct connection to the battery was the best method to obtain power for the radio. This, however, presented me with an interesting dilemma. I was thrilled to have the radio but hesitant to connect equipment directly to the battery for fear of causing costly damage to the vehicle's electrical system. What I needed was a method to protect both the vehicle's electrical system and the radio equipment from subsequent power problems.

The power panel described in this article was designed to protect the vehicle and radio equipment. I have also used this opportunity to standardize the connectors on my own equipment, including the power panel and a 13.5 VDC supply. This simplifies movement of my equipment between various vehicles and my home QTH.

The power panel incorporates two levels of overload protection. The primary source of protection is provided by a set of inline, 15 amp, fast-acting fuses that are located close to the positive and negative battery terminals. These primary fuses guard against potential shorts from cable chafing and abrasions inside the engine compartment. A secondary level of overload protection is provided by a set of 7 amp fast-acting fuses which protect against electrical overload from high power equipment and potential cabling problems within the vehicle's cab. The secondary fuses are physically located on the exterior of the main power panel to allow quick access and easy replacement.

The almost inevitable need for noise suppression was satisfied by incorporating a filter network into the unit, thereby avoiding the unsightly rat's nest of wires which is sure to result if independent components are installed later. The power panel also incorporates an analog meter to monitor the current passing through the output connector. The meter is not essential for the system's operation and may be omitted if desired. I have, however, found this option to be particularly useful for monitoring the nominal current drawn from the battery during various operating conditions.

The power panel schematic is shown in Fig. 1. The 30 µH filter choke was constructed by winding 12 turns of 16 AWG insulated wire onto a T-200-1 powdered iron core. The 50 µA, 2.56k ohm analog meter movement utilizes the filter choke's 0.012 ohm winding resistance as a current shunt. This increases the full scale meter reading to approximately 10 amperes. The meter face has been highlighted in red from the 7 ampere mark to allow quick identification of the secondary fuse meltdown point.

The power panel also includes a relay which disconnects power when the ignition is off. The relay is activated by a separate power connection to an "Accessory" slot on the vehicle's fuse block. This prevents the radio from draining the battery if the unit is accidentally left on.

Construction of the power panel is fairly easy as no circuit board or special wiring techniques are required. All connections were made on a single barrier strip mounted inside the metal cabinet. I did, however, solder a 20 AWG wire directly to each end of the choke to prevent inadvertent disconnection as removal of the shunt resistance would allow the supply current to pass through and destroy the panel meter. Connect the opposite end of each of the smaller wires to the meter movement.

I produced the current version of the power panel in less than two hours. An additional hour was required to install the unit in my car. The time invested was well worth the effort as I can swap radios in under five minutes and not compromise my vehicle's electrical system. 73

Parts List

50 µA, 2,560 ohm analog meter movement (Mouser #564-72T-1050 or equivalent)
T-200-1 powdered iron core (Amidon Part #T-200-1)
2200 µF, 25V electrolytic capacitor
(2) 7 ampere, fast-acting fuses with panel mount holders
(2) 15 ampere, fast-acting fuses with inline holders
36" section of 16 AWG insulated wire
12 AWG THHN or equivalent wire (enough to reach from battery to power panel)
DPDT switch with contacts rated 10 amps (minimum)
12V lamp with holder
Panel-mount, female connector, 10 amp contact rating (minimum) and mating male plug
6-position or larger barrier strip
6-10" of small gauge wire
Metal cabinet
Misc. hardware
12V SPST relay with N.O. contact (Mouser #526-R22-1D16-12 or equivalent)

Mouser Electronics: (800) 346-6873.
Amidon Associates: 12033 Otsego Street, North Hollywood, CA 91607.

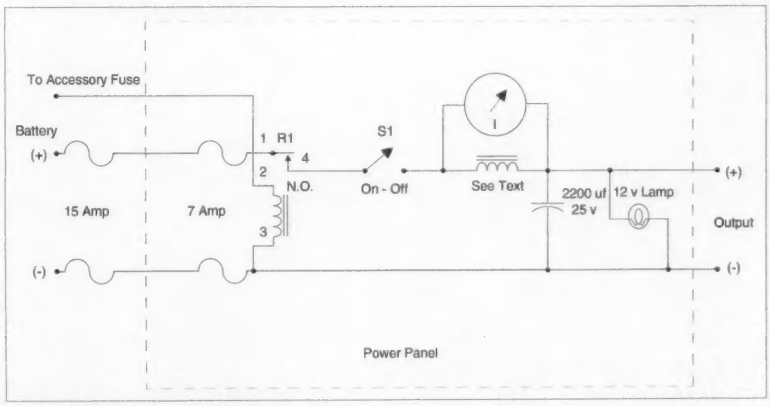


Fig. 1. Schematic for the power panel.

Do You Remember?

Glen E. Zook W5UOJ
410 Lawndale Drive
Richardson TX 75080

Every once-in-a while, many amateurs like to take time to reflect, time to remember. About 20 years ago I wrote a similar article which Wayne published in *73* which met with a favorable response from the readers. This one has been updated somewhat, but is still aimed at the over-25 crowd. Over 25 years as an amateur, that is, the QCWA crowd. However, newer amateurs might just get a kick out of trying to make sense of the following list. But, if you have to ask any questions, then you really don't remember.

So, without further ado:

Do You Remember?

The "Sixer," "Twoer," and "Tener"?

ARC5s?

The "Dream Receiver" (the one I owned was more like a "nightmare"!)?

The BC779?

The "My QTH" QSL cards?

When VO was a separate country from VE?

When the "ideal" Novice rig was a DX40 and an SX99?

Controlled carrier modulation?

DSB?

The SX101A?

The VF-1 VFO?

The DX20, DX35, and DX60?

The 30L1 transmitter (not the 30L1 linear!) by Collins?

The KWM1?

The original "Bandit"?

The TBS50D (160 through 2!)?

The HRO series?

When an 807 was a tube, not a drink?

The 814?

The G66 and G77?

The one-eyed "Gooney Bird"?

The second generation "Gooney Bird"?

When Novices could operate 2 meter phone, but Technicians couldn't?

Crystal control and 75 watts?

When the "Adventurer" and "Challenger" were not space vehicles?

The Drake TV300HP?

Using a BC459 or BC457 as a VFO?

"Rice boxes" and "Japtracs"?

The 16V and 30D?

8th MOs (and even earlier!)?

The 41V and 80D?

The 75A1?

The AF67 (or even earlier, the A54H)?

When a "tribander" was a converter, not an antenna?

The NC240D?

The NC183D (or even earlier, the NC173)?

The "Sky Buddy"?

The S40B?

The S77?

Globe Chiefs and Globe Scouts?

The Apache, Mohawk, and Seneca?

The Mohican?

The KWS1?

Leo?

When Leo had hair?

The orange QSL cards from Walter Ashe?

The logbook QSLs from GE?

HI HI HI HI from space on CW?

The Invader and Invader 2000?

Pedestals?

The quad at HCJB?

The Central Electronics 10B and 20A?

The CE 100V?

Modifying a BC458 to use with a CE 10B or 20A?

The Techcraft coverters?

International Crystal 6 meter rigs?

The Lincoln?

Knight Kits?

The R100A?

The Swan 120 (or 175, or 140)?

The Swan 240?

Heath monobanders?

The HQ129X (or, even earlier, the HQ120X)?

The SP600?

Your first QSO?

"Bugs", not keyers?

The Vibroplex Champion and Standard?

Astatic?

When W9IOP (also W8IOP, W2IOP, etc.) won the Sweepstakes every year?

W9VW (hint: Look at W9IOP DX contest scores)?

The 75A4?

The S85?

The HQ105TR?

When Johnson built only ham gear?

The AT-1 and AR-1 (I owned an AR-3)?

6AG7-807 (or even 6V6-6L6)?

The 2E26 and 6146?

When the 829B was the "cat's meow" on 2 meters?

The SCR522?

ROWH (Royal Order of the Woulf Hong)?

ROHO (Royal Order of the Hoot Owls)?

"No lids, no kids, no space cadets..."?

W2OY (I got on his "reserved" frequency once!)?

W5IO ("I know this guy, he bought a donkey...")?

ZL2BE (and his 20 wavelengths on a side rhombics)?

The rhombic?

100 North Western in Chicago?

When Lafayette was across the street from Allied?

When Radio Shack bought Allied?

Olson?

"California Kilowatts"?

AGL Electronics?

6 Up Magazine?

Western Radio Amateur?

When W2NSD ran *CQ*, not *73?*

Cowan Publishing?

Zepp Antennas?

The T2FD?

"Radiates equally as poor in all directions"?

The DX100?

The SB-10?

The quad-versus-yagi debate?

AR22 rotors?

Prop pitch motors?

Selsyns?

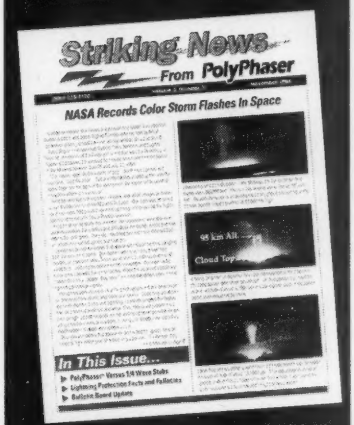
The Communicator III?

WR calls?

When an "X" call meant experimental?

Continued on page 60

Do You Know...



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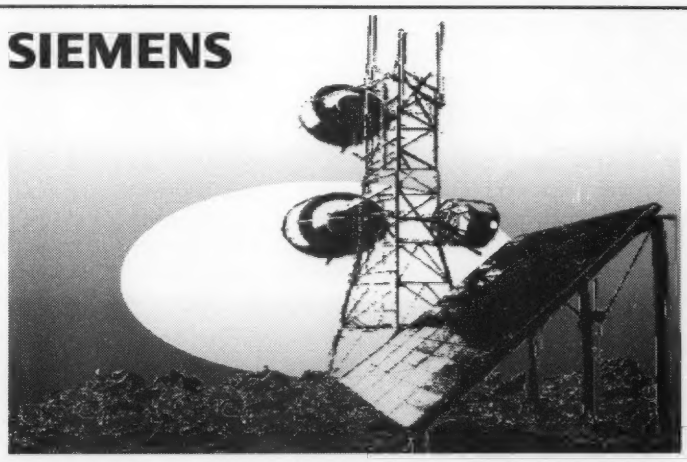

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When I first decided to build my own packet modem I was surprised that not much information was available. After doing lots of research, reviewing technical notes from the modem chip manµFacturer, and experimenting, I found that the modem chip could work with only a few added components. I have used this design for over a year as of this writing and it works well. Members of our local club have also built this project and are happy with the results.

Uses

This modem is designed to work with the serial port of most IBM-compatible computers. A software TNC program is required for operation and most BBSs have shareware TNC programs available for downloading. Known compatible programs are Baycom and SofTNC from j•Com. (Although SofTNC works well when configured for com 1, I have not yet been able to get it to work on com 2.) I have seen numerous other software programs and drivers on the Internet for this type of modem that allow TCP/IP use, games, and Windows-compatible programs, etc. With the simplicity of this setup I am sure that others will continue to be developed.

Circuit Analysis and Operation

The software TNC program is the heart of this setup. Most of these programs have the same major features in common. They provide a memory-resident AX.25 packet protocol, a user terminal interface to send and receive from, and a means to access the computer's serial or parallel port. It should be noted that most software TNC programs do not use the standard RS-232 pins of the serial port. They use the DTR line for TXD, the CTS line for RXD and the RTS line for PTT. Therefore, these programs were written specifically for this type of modem.

Photo A. The author's Basic Packet Modem setup with radio, cables and laptop.

Refer to the schematic, Fig. 1. Power is supplied to the modem from the computer by the TXD, DTR and RTS lines of the serial port. Diodes D1, D2 and D3 allow the positive voltages to reach the voltage regulator VR1 to power the circuit, but do not allow these lines to interfere with one another. Most software TNC programs will raise the TXD line of the serial port high constantly while the program is running. They will also keep the DTR line high while receiving. When the RTS line goes high to key the radio, the DTR line will send data by toggling high and low. The high TXD, high RTS when keyed, and high pulses of the DTR line provide power to VR1, which supplies the circuit with the required 5 volts. Capacitors C1 and C2 provide filtering and stability of the regulator and the output voltage.

IC2 is a 74HC04 CMOS hex inverter. It draws less current than a standard 7404, which is why it was chosen for this circuit. It performs the dual functions of inverting the appropriate signals and serving as a pseudo RS-232 to TTL line converter.

To key the radio, the software raises the RTS line of the serial port high. Since almost all radios require their PTT line to be pulled low to key the radio, this high level must be converted to a low level or ground closure. The high RTS goes to pin 3 of the inverter and is converted to a low output on pin 4,

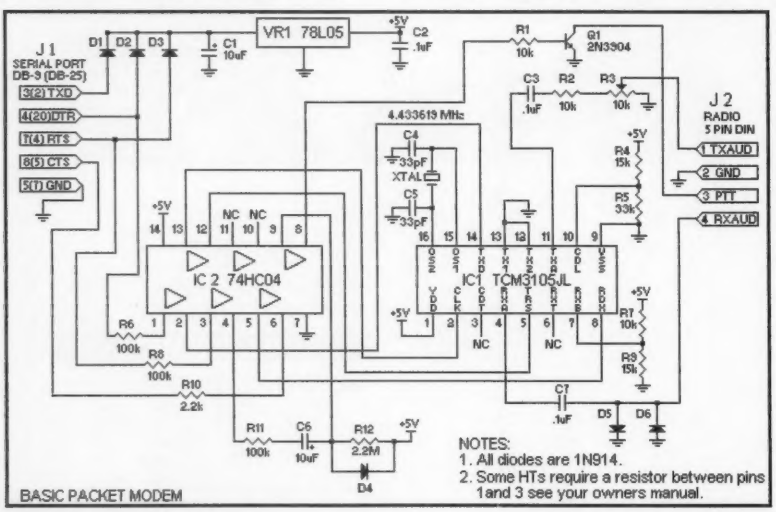

Fig. 1. Schematic for the modem.

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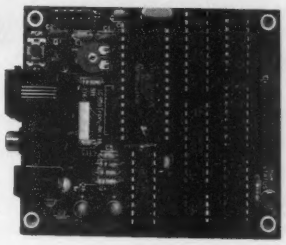

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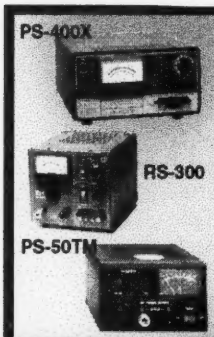
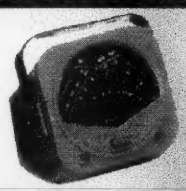


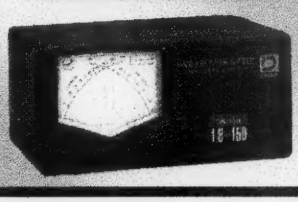
Model	PS-400X	RS-300	PS-50TM
Input Voltage	AC 230 or 117VAC on ODR, ±5%		
Output Voltage	1-15VDC variable		13.8V fix.
Output Current MAX.	40A	30A	5.2A
Output Current Rating	32A	24A	4.2A
Votlage Fluctuation	Less than 1%		Less than 2%
Ripple Voltage	Less than 3mV (with rated output)		
Protection Circuit	when 42A	when 32A	when 5.2A
Dimensions (WHD, MM)	216x110x280	172x150x240	135x87x200
Net Weight	8.5kG	8.9kG	2.5kG
Power Consumption	690W max.	600W max.	120W max.

CN-400 Series



Model	CN-410M	CN-460M	CN-465M
Freq.	3.5-150MHz	140-450MHz	
Power Range Forward	15 W/150 W		15 W/75 W
Power Range Reflected	5 W/50 W		5 W/25 W
Tolerance	Better than ±15%		
SWR Detection Sensitivity	3 W min		
Dimensions/weight	71W x 78H x 100D mm/300g		

CN-101 Series



Model	CN-101L	CN-103L
Freq.	1.8 - 150MHz	140 - 525MHz
Power Range	15/150/1.5kW	20/200W
Power Rating	1.5kW (1.8-60MHz) 1kW (144MHz)	200W (140-525MHz)
Tolerance	±10% (of full scale)	
SWR Detection Sensitivity	4W min.	

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where it is routed to a time-out circuit and to pin 9 of the inverter. The low on pin 9 is converted to a high on pin 8 that turns on Q1. When Q1 turns on, it provides the low or ground closure for the PTT of the radio.

The keying time-out circuit is provided in case the software hangs up or you run another program that raises the RTS line high. It prevents your radio from either causing interference on the channel or burning up! The circuit is comprised of capacitor C6, resistor R12, and diode D4. As soon as the software raises the RTS line high, pin 4 of the inverter goes low. This allows C6 to start charging through R12. After C6 charges to about one time constant (approximately 20 seconds), the voltage "seen" at pin 9 will be high enough to cause pin 8 to go low, thus unkeying the radio. C6 will continue to charge until it reaches a charge close to the supply voltage. D4 is provided to keep pin 9 from seeing the 5V supply to the timer circuit. When the RTS line goes low, C6 will discharge and the timing circuit will begin again on the next key.

IC1 the TCM3105JL chip is the main component of the circuit. It is a single chip asynchronous Frequency Shift Keying (FSK) voice band modem that can be jumper selected to the Bell 202 modem standards. A pin-by-pin description of the modem chip follows:

Pin 2 (CLK) is a clock output. It is sent to the hex inverter and then fed back to pin 5 (TRS) of the modem chip to provide an inverted clock signal for Bell 202 mode.

Pin 3 (CDT) provides a carrier detect output. It isn't used on most serial port software TNC programs, but can be hooked up for certain applications that may require it.

Pin 4 (RXA) is the receive audio input. C7 is an AC coupling capacitor and D5 and D6 form a clipper circuit to limit the audio input to the modem chip.

Pin 7 (RXB) is the receive bias. The bias voltage tells the modem's internal comparator at what level to slice the DC variations fed to it from the internal multivibrator demodulator.

Pin 8 (RXD) is the comparator's output. This is the receive data that is inverted and then fed to the computer's CTS port.

Pin 10 (CDL) has a level set by R4 and R5 for the pin 3 (CDT) output.

Pin 11 (TXA) output of the modem. It is AC coupled by C3 and its' level is set by R2 and R3.

Pins 12 (TX1) and 13 (TX2) are strapped together and tied low for the Bell 202 mode.

Pin 14 (TXD) transmit data from the computer's serial port is inverted and then sent to modem on this pin.

CIRCUIT BOARD TO J1 SERIAL PORT CONNECTIONS

CIRCUIT BOARD	FUNCTION*	J1 CONNECTOR, DB-9	OR DB-25
TXD 3	POWER	3	2
DTR 4	TRANSMIT DIGITAL DATA/POWER	4	20
RTS 7	PUSH-TO-TALK/POWER	7	4
CTS 8	RECEIVE DIGITAL DATA	8	5
GND 5	GROUND	5	7

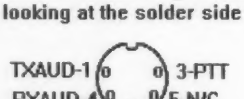
Note: The functions listed are referenced for this modem. They are not standard RS-232 functions.

Fig. 2. Pinouts from the circuit to the enclosure's J1 data connector.

CIRCUIT BOARD TO J2 RADIO CONNECTOR

CIRCUIT BOARD		FUNCTION	J2 5-PIN DIN
TXAUD	1	Transmit Audio	1
GND	2	Ground	2
PTT	3	Push-to-Talk	3
RXAUD	4	Receive Audio	4

Look at your 5-PIN DIN connector numbering carefully; it is not numbered in sequence. This view, looking at the solder side of the chassis connector, should help:



Modem Chassis Connector Solder Side

Fig. 3. Pinouts from the circuit board to the enclosure's J2 radio connector.

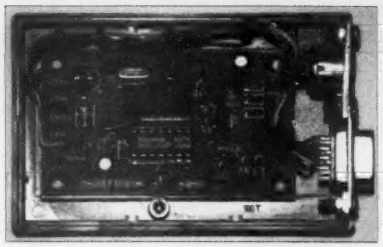


Photo B. The completed circuit board installed in case.

Pins 15 (OS1) and 16 (OS2) are the connections for the 4.433619 MHz crystal and C4 and C5 capacitors which set the frequency for the on-chip oscillator.

Construction

Construction is pretty straightforward. See the Parts List and refer to the schematic diagram (Fig. 1) for component interconnections. When installing the parts, observe proper orientation of the diodes and capacitors. Note that the miniature voltage regulator looks identical to the transistor, so check them before you install. To prevent damage to the ICs, use sockets and install them last. You can construct this circuit on perf board. I have built one this way, but it was pretty messy, so unless you are a skilled perf board builder the printed circuit board is recommended. See Fig. 6 for the circuit board layout.

Enclosure

The enclosure listed in the Parts List is small and has a removable battery cover to accesses the potentiometer R3 level adjustment. If you chose to use this enclosure you will have to remove the battery compartment divider by carefully cutting it out with a hobby knife or rotary cutter. Do not try to bend and break it out, because you will probably destroy the enclosure. Use the front panel and carefully drill and file to mount the 5-pin DIN chassis mount connector and the 9-pin D-SUB female with 4-40 screws and hex nuts. It may be necessary to file the corner off the 9-pin D-SUB connector for both of these to fit. Do not overtighten the screws or you will damage the front panel. A sturdier front panel can be made from aluminum cut to the same size as the plastic panel.

Use short runs of wire and connect the circuit board to the appropriate pins of the connectors on your enclosure. Refer to Fig. 1, 2, and 3.

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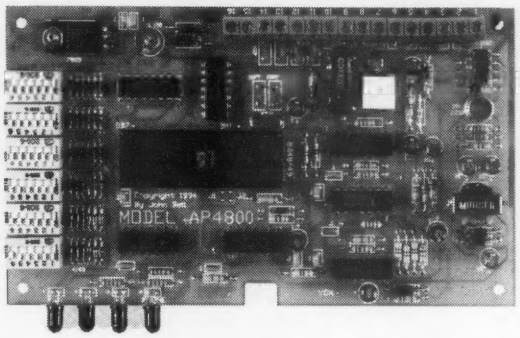

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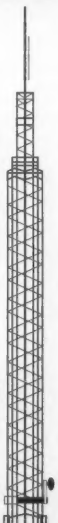

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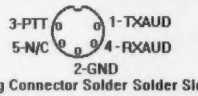
DB-9	OR DB-25		DB-9	OR DB-25
3	2	POWER	3	2
4	20	TRANSMIT DIGITAL DATA/POWER	4	20
7	4	PUSH-TO-TALK/POWER	7	4
8	5	RECEIVE DIGITAL DATA	8	5
5	7	GROUND	5	7

Note: The functions listed are referenced for this modem. They are not standard RS-232 functions.

Fig. 4. Pinouts from the computer to the modem interface cable.

5-PIN DIN		FUNCTION	RADIO CONNECTOR
TXAUD	1	Transmit Audio	A/R *
GND	2	Ground	A/R
PTT	3	Push-to-Talk	A/R
RXAUD	4	Receive Audio	A/R

Look at your 5-PIN DIN connector numbering carefully; it is not numbered in sequence. This view, looking at the solder side of the plug connector, should help:



Plug Connector Solder Solder Side

Note: Refer to you owners manual for the pin-out of your radio connector.

Fig. 5. Pinouts from the modem to the radio cable.

Computer Data Interface Cable

Some computer data cables are on the expensive side and since you have already built your own modem; why not build your own data cable? A standard data cable will work, but for this interface five lines are all that is required. Refer to Fig. 4 for the pinout. If you purchased the bulk data cable in the Parts List, the shield counts as the fifth conductor (GND). The shield should be twisted together and have heat shrink put over it to form a wire. You may also want to put some heat shrink over the data cable where it enters the backshell. This will provide firmer clamping once the backshell is assembled. Note that this cable is for this modem only. It won't work with a landline-type modem, because some of the other lines required are not used in this interface. You can build a cable to go from DB-9 to DB-9 or DB-25 if your computer has a DB-25 serial port.

Radio Interface Cables

The stereo cable for most audio systems and VCRs makes a great interface cable for handhelds. It gives you two separate cables for each of the radio connectors to attach, but is still joined together as one cable. Simply cut the phono plugs off and cut the cable to the desired length. You may want to put a small piece of heat shrink over the cable to keep it from "zipping" apart. Then attach the radio mini-plugs. Refer to your owner's manual for the proper pinout of the radio plugs and to see if a keying resistor is required for your handheld. Handhelds that have no separate push-to-talk line incorporate it into the transmit audio line of a remote microphone. This transmit audio line has a DC logic high that is usually "blocked" by a capacitor installed in the mike. In the modem circuit capacitor C3 performs this "blocking" function. An AC audio signal can coexist on this same line without the DC signal interfering. When the PTT line of the modem goes low the keying resistor causes a voltage drop from the DC high, thus making the radio key without shorting the audio signal to ground. If your radio needs this resistor it can be easily installed inside the backshell of the 5-pin DIN plug between the TXAUD line and the PTT line. Usually a 2.2k or 3.9k resistor is used, depending on the make of the radio, so check your owner's manual for details.

For mobile rigs, the same cable type that was used for the serial port interface cable can be used. You may want to add some heat shrink where the cable enters the backshell of the radio connector to provide better holding when the clamp is tightened down. Refer to your owner's manual for the proper pinout of the radio connector. Most mobile rigs can have the PTT line hooked up directly without a keying resistor. The pinout for the 5-pin DIN mating plug for the chassis mount plug is shown in Fig. 5.

Setup and Adjustments

If you are new to packet now is a good time to invite someone with packet experience to help you. They will be familiar with the various packet settings in the configuration file of your software, and may be able to help if you have any other problems. If no such person is available, I'll try to give you some brief pointers to get started. Read the documentation for your packet program thoroughly. Set up the configuration file for your callsign, COM port and any other custom information for your computer, etc. Turn off your computer (most computer manµFacturers recommend doing this before hooking up peripherals to ports). Hook up your radio and computer to the modem then turn on the computer and run the TNC program. Unsquelch your radio and adjust the volume just to the point where the RX indicator of your program comes on or flashes. It is not necessary to increase the volume beyond this point.

If you are on an active packet frequency you should now be able to monitor decoded packets on the screen. If not, check your software setup and manual. Read the instructions for your software on how to connect to another station. Hopefully everything is working fine. If not, here are some troubleshooting tips.

Troubleshooting

If your modem is not working properly, don't panic. It is usually something simple. Listed below are some of the common problems, solutions and troubleshooting tips. All of these tests require that your modem be connected to the computer, with the software TNC program running. If, after following these steps, you still have no luck, use a multimeter, the schematic shown in Fig. 1, and the theory of operation section to track down your problem.

Using a multimeter, check for continuity and shorts in the interface cables to

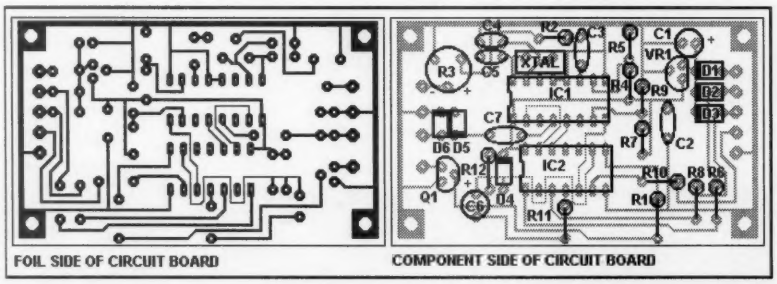


Fig. 6. Circuit board and component layout.

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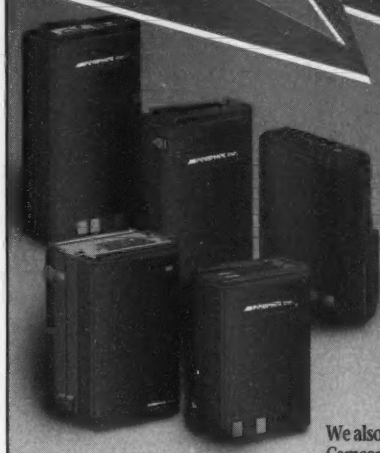

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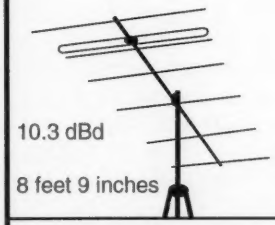	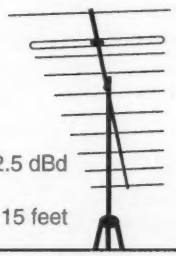	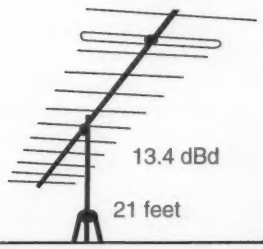	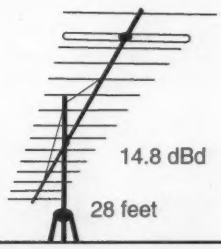
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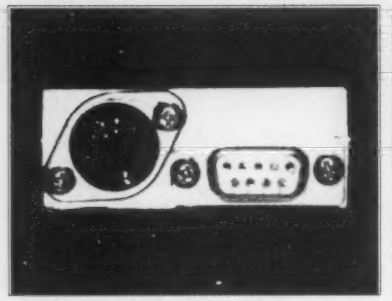

Photo C. The front panel showing the 5 Pin DIN radio connector and the DB-9 computer connector.

the radio and computer and wiring to the connectors and circuit board of the modem.

Make voltage readings on IC1 pins 1 and 9, IC2 pins 14 and 7. You should have a voltage very close to 5V. If not, check for a 5V output on VR1 at the point where it connects to C2.

If your radio keys up and you are using a handheld with a keying resistor, try reducing R3 until it unkeys. If you still cannot get the radio to unkey and are sure everything else is OK, R2 may have to be replaced with a lower value resistor.

If you are not receiving packets, first make sure that the software TNC program you are running will allow you to monitor what is happening on an active channel and that you are using the proper serial port. Then find the status indicator of your program. When your S-meter or busy indicator shows activity on your radio the RX or RECV indicator of your program should light. If not, try unsquelching your radio . White noise from the radio will cause the indicator to light if the volume level is high enough. It should not be necessary to turn the volume above halfway. If you see no receive indication, check for power to the modem.

If others are having trouble decoding your packets try the R3 adjustment that affects the audio output level. In testing,

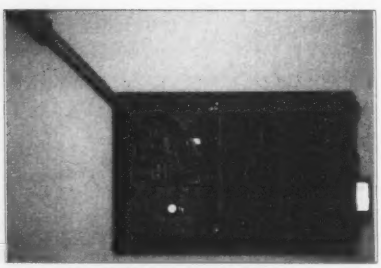

Photo D. The bottom cover of the case removed to get to the audio level adjustment.

over-deviation was almost impossible with the radios tested. However, distortion was not. Too high a setting will cause the audio to be distorted and the receiving station may have some problems decoding your packets. If you see too many REJs (REJECT), try lowering the output slightly. Usually, about midway works fine. Also, try increasing your transmit delay time in your TNC software program.

If your radio is not keying and it is a handheld, refer to your owner's manual to see if it needs a keying resistor. Radios that use this resistor will not key properly without it. For radios using a separate PTT, disconnect the cable from the radio and connect an ohmmeter between the PTT line and GND. When the program transmits, you should see close to 0 ohms. Also, check to see that Q1's emitter is grounded to the radios' ground when the cable is hooked-up, and that the base of Q1 is going high when the program transmits. If not, check for power to IC2. If that is OK, see if pin 3 goes high when the program transmits. If not, either the program is set up for the wrong serial port or there is a problem with the serial port.

A quick check to see if your modem is active and transmitting packets can be done by unhooking the connector(s) from the radio and hooking headphones with some jumper clips to the TXAUD and GND lines on the radio connector(s). You should hear a low-level high-pitched continuous tone. When you send a transmission such as a connect request, a familiar packet burst sound should be heard momentarily, then the continuous tone will return. If you obtained these results, the modem is on and is transmitting data.

If your setup is working but acting erratically or the computer locks up, etc., RF is probably getting back into the computer or modem. The effect of RF appears as your computer monitor's picture jumping with each transmission relative to the power level you're operating at and the location of the antenna. The radio may also stay keyed after the first transmission or cycle back and forth. Usually it will help if you remote your antenna away from the packet setup or reduce power. For handhelds, use an antenna extension cable for mobile use with a rubber duck antenna or an outdoor antenna that can be located away from your station. Computers and monitors can generate a lot of noise. This may get into your receiver and be strong enough to keep your radio unsqelched. Again, moving

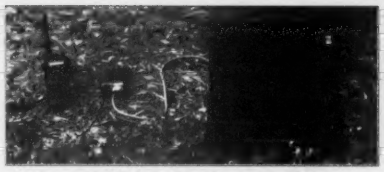

Photo E. The Basic Packet Modem is very portable and requires no external power.

your antenna or moving the location of the radio or cables should solve the problem. Some of the later versions of TNC software programs have a carrier command that can be set up for unsquelched operations. I have used this with much success.

Tips for 10 Meter Operation

Packet on 10 meters can be used between 28.0 and 28.3 MHz sideband. You can usually find packet stations on the lower sideband. Check your repeater directory for listings of 10 meter packet BBSs. Running sideband packet is a little different from 2 meter. Tuning is a little more critical, but once you get it dialed in you should have no problem. Also, if you are working DX packet stations, try increasing your retry count. It sometimes takes a little longer if the band is fading back and forth. It is possible to run unsqelched on sideband due to the lower receiver noise on sideband. First, set the volume so that the receive indicator of your software just comes on. Then back it off some just till the indicator goes out. When packets come in, the audio level is higher than the noise level of the receiver, and the software TNC program will go to receive mode and decode the packets. When the band is open strong, this works great. If the band is a little weak and fading in and out, you may have to "work" the volume control of the radio some. Using squelch on sideband will require the sending station to use a much longer transmit delay time. This longer delay time will send an audio preamble before any data is sent. Since audio is required for the squelch of a sideband radio to break, the audio preamble will first break your squelch. After the preset delay time, the data will be sent. If you are going to do lots of 10 meter packet, I highly recommend a software TNC program that has the carrier command for running open squelch.

Conclusion

I hope you have as much fun with this project as I did. I also hope that it has taken some of the mysteries out of packet and encouraged you to

experiment on your own. By putting the "brains" in the computer, programmers can come up with limitless options and upgrades that we can all afford. 73

(Photos by Jay McClain N3HUH.)

Parts List

All resistors are 1/4W, 5%-tolerance carbon-film unless otherwise specified.

C1, C6—10 µF, 50V, radial-lead electro lytic capacitors (Jameco 29891)
C2, C3, C7—.1 µF, 50V capacitors, ceramic (Jameco 15270)
C4, C5—33 pF, 1,000V capacitors, ceramic (Jameco 97244)
D1-6—1N914, diode (Jameco 36038)
Q1—2N3904, transistor (Jameco 38359)
R1, R2, R7—10k (Jameco 29911)
R3—10k PC-board horizontal-mount trimmer potentiometer (Radio Shack 271-282)
R4, R9—15k (Jameco 30146)
R5—33k (Jameco 30841)
R6, R8, R11—100k (Jameco 29997)
R10—2.2k (Jameco 30314)
R12—2.2M (Jameco 30365)
IC1—TCM3105JL Texas Instruments Bell-202 modem chip (Marshall Industries, 932 Telstar Ave, El Monte, CA 91731; tel: 1-800- 522-0084)
IC2—74HC04 hex Inverter (Jameco 45209)
VR1—78L05 miniature voltage regula tor (Jameco 51182)
XTAL—Crystal 4.433619 (Jameco 102630)
16-pin IC socket (Jameco 37372)
14-pin IC socket (Jameco 37161)
5-pin DIN chassis mount connector (RS 274-005)
5-pin DIN plug (RS 274-003)
9-pin D-subconnector, female (RS 276-1538)
Enclosure (RS 270-293)
Radio connector(s) as required for your radio

Jameco Electronic Components,
1355 Shoreway Rd.,
Belmont, CA 94002-4100
phone: 1-800-831-4242

A kit containing circuit board and components is available for $34.95 + $5.00 S&H from:
LDG Electronics,
1445 Parran Rd. St.
Leonard, MD 20685
Phone 1-410-586-2177.
Visa and MasterCard orders are accepted.

LETTERS

Continued from page 6

I was an avionics officer in a special operations unit. I am an Air Force Reserve colonel today, attached to one of the alphabet agencies. Along the way I earned a B.A., B.S.E.E., M.B.A., and finally a Juris Doctor degree. The law practice supports my Air Force Reserve activities and pays for the DC-to-light ham gear. Thanks for the inspiration along the way!

Now for the important part. I just completed teaching three classes of sixth-graders a little about ham radio, shortwave listening, and opportunities in electronics as a career. I also donated $200 in "Now You're Talking" books to the school library and arranged classes with the local club. I also have given two subscriptions to your magazine to kids. My son, Barry KE4PUD (Passed Up Dad), earned his Novice license at age 9 and upgraded to Tech Plus at age 10. He is now 11 and working on the General.

If possible, please publish this little story as an incentive for some other aging Baby Boomers to get off their rears and invest some time and money in the future. Get the kids interested in electronics and engineering. If we do not help to mold the next generation there will be no amateur radio and a lack of engineers and technicians in the future. Please continue publishing and leading.

Sorry about 6-Up, *but it was a 1965 victim of the state employment police who stopped me from using high school kids for 50¢ an hour after school to address and mail the little magazine unless I paid them at least the minimum wage. The kids were happy to make some money and learn about publishing, but the employment department wouldn't let them do it, so I had to give it up. Hey, keep up the work with the kids, that's fantastic. . . Wayne)*

Jeff Olstad, BC. In response to your "Whadaya Read?" in the September issue, I am a flat beginner. I don't have my first license yet. I bought this issue to try and learn more about ham radio in general and more specifically antennas. It is my second issue of the magazine. When I read my first copy I thought if this magazine's circulation is good they would not listen to any advice from me, but seeing as you asked, I thought I would try to explain what I think. It is pretty obvious to me why your circulation is suffering. You insult the people who should be the bulk of your readers in many articles: the licensed operators. For beginners like myself you use so many abbreviations and make so many references to things you don't explain. Without a comprehensive reference library it's unreadable. So who is left that has any use for *73?*

(Thanks Jeff, sort of. First, you should be collecting 73 *magazine issues so you'll have a valuable encyclopedia of ham information that you're going to need later on, after you've come up to speed. Get out to hamfests and collect as many back issues as you can find. They're solid gold when you want to get started with RTTY, packet, SSTV, and so on. Second, the magazine's circulation isn't suffering, it's doing fine. I just want it to do even better. Third, what's all this about insulting people? Anybody else have a problem with that? Sure, I'm on your case about losing weight, stopping smoking, and not wasting your time with baloney like ball games and sitcoms when you could be reading and educating yourself...there being a known correlation between education and success. Or getting more involved with hamming and having a ball while you are learning. But I wasn't aware I, or any of our columnists, have been insulting about it . . Wayne)*

Continued on page 35

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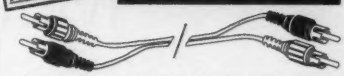

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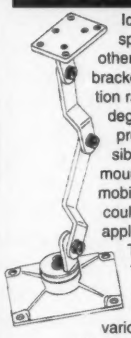

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Take UHF power measurements? No problem. I simply place a diode across the 50-ohm line and the power will be

$$\frac{E^2}{R}$$

—and don't forget that the diode is a peak-reading device. Then I multiply the peak by 0.707 to bring it down to the RMS value. This means I'm assuming a sine wave input. Do I really have a sine wave?

Another thing: Diodes have lead-length inductance and junction capacitance. I wonder what that's doing to my load line? And speaking of the diode, everyone knows a diode is linear except at the lower levels. I wonder at what level this nonlinearity starts, and what the characteristics are? Also, there must be a diode rolloff. Where does that start?

These are the kinds of questions that come up when you measure RF power using a diode detector. The following article describes simple methods that address such considerations, and the hardware you can build to make accurate measurements.

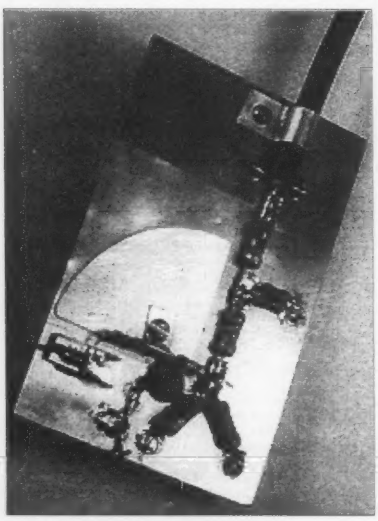

***Photo A.** The dummy-load/detector.*

This hardware includes a dummy-load/detector assembly (see Photo A) permitting 0.2 mW to 5 watts power measurements down to 70 cm, and a separate 10 dB attenuator (see Photo B) that increases this capability to 50 watts. Also included is a very simple thermal-type power measuring device for calibrating the peak reading diode assembly versus RMS input power. All parts for building these assemblies are available at Radio Shack®.

Dummy-Load/Detector

See Fig. 1. Two 100-ohm, 1/2-watt resistors in parallel connected across a 50-ohm cable with near zero lead lengths will be very close to a 50-ohm termination with the SWR less than 1.1:1.

However, adding the diode introduces capacitive loading that results in an SWR of 1.5:1 or more. In the circuit, the components on the 2 dB resistor pad preceding the diode/load compensate for this, as they are tailored to reduce the SWR to less than 1.1:1. Using the simple directional coupler described in my article "Non-Etched SWR Bridge" in the September 1987 issue of *73*, I confirmed the SWR.

Although the power capability of this assembly is 5 watts, forced-air cooling is required at the higher power levels, depending on the measurement period.

The 10 dB Attenuator

See Fig. 2. Inserting the 10 dB attenuator increases power measurement capability to 50 watts. Although it has an attenuation of 10 dB at lower frequencies, at 2 meters and 70 cm, circuit losses increase to 10.8 dB and 12.0 dB, including interconnecting RG-58/U cable losses of 0.4 dB and 0.6 dB, respectively.

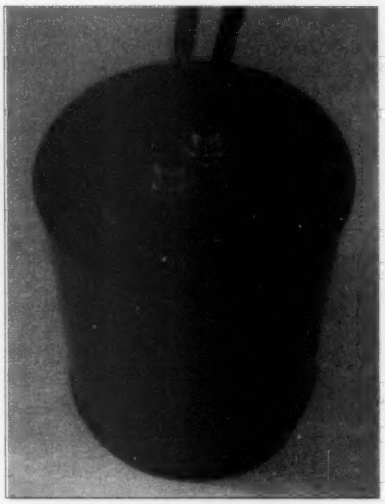

***Photo B.** The 10 dB attenuator.*

Establishing an SWR of less than 1.1:1 at 70 cm was the most critical design consideration. Changes occur with different coolants. If the assembly is tailored for minimum SWR in air, its SWR increases to about 1.3:1 when you put it in vegetable oil. The SWR changes are caused by increased circuit capacitance due to the dielectric. This condition was improved by using household wax, paraffin, instead of oil. *Caution: Paraffin has a relatively low flash temperature; it can be used to make candles.*

Next, to decrease the circuit distributed capacitance, I increased the distance of the components from the circuit board by stacking two layers of PCB at the tie-down pads. This raised the parts connecting positions to about 0.120". The completed assembly has an SWR of less than 1.1:1 at both 70 cm and 2 meters.

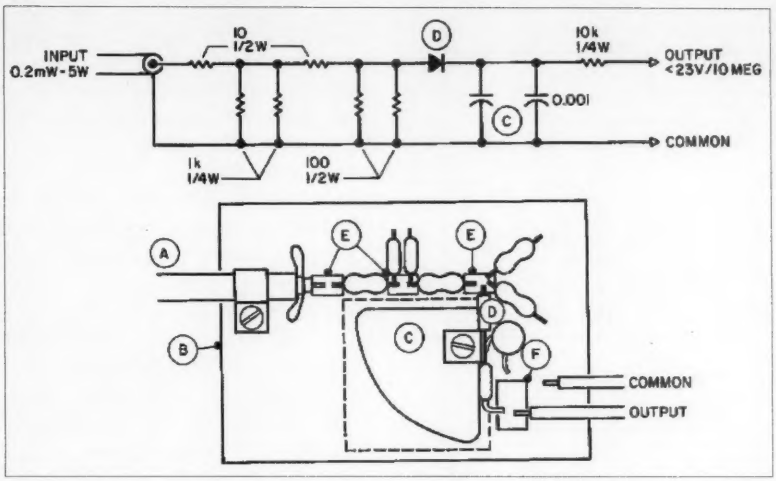

Fig. 1. Schematic and layout of the dummy-load/detector assembly. A. Input, 1' RG-58/U. Fan out braid on connecting end, twist in two segments; solder to PCB with minimum lead lengths. B. Base, 3" x 2" x 1/16" PCB. C. Capacitor. 90 degree circular sector, 1" radius, 0.21"-thick Reynolds sheet aluminum. Surface polish with 220-grit sandpaper to remove burrs. Dielectric, 2.7 mil polyethylene (Ziploc® heavy duty freezer bag). Feed through 2-56 screw with a plastic insulator on the back side. Hole is reamed on both sides with a large drill to prevent shorting to the foil. D. Peak readout diode, 1N34A selected to have a reverse resistance of less than 5 megohms (RS 276-1123). E. Component tie-down pads, 1/4" x 1/8" x 1/16" glass-epoxy PCB. Cemented to base with clear household cement (Elmer's®). F. Output tie-down pad, 3/8" x 1/4" x 1/16" PCB.

Paraffin starts to melt at about 150° F and expands as it melts. You may have a lighted candle on your bench if the components are not immersed in the wax during power dissipation. The container must breathe, and be in an upright position when there is moderate to high power inputs.

The wax may develop voids near the surface when cooling down. Note from the layout that the circuit board is longer than the circuit, forcing the circuit towards the container bottom, away from the wax surface voids. With a 50-watt input, it takes approximately half an hour to liquefy all the wax in a one-pound container.

You can easily calibrate the linearity of the dummy-load/detector assembly with a low-frequency RMS voltage. I use the 60-cycle line with an old step-down transformer and a variac so that I can vary the voltage from about 0 to 50 volts RMS. You can make a 50-ohm source by placing a 50-ohm resistor between the actual output and the transformer AC source (a source impedance of about 5 ohms is considered negligible).

Making Measurements

First, insert the 10 dB attenuator between the 60-cycle line source and the dummy-load/detector assembly. The source is adjusted to a specific diode output value—3 volts, for example. Next, remove the attenuator and note the increased diode output with the dummy-load/detector assembly connected directly to the source. In this case, the value was 9.48 volts. The ratio of the two voltages will be the result of the loss through the attenuator and any change in diode characteristics due to the two different RMS input voltages.

In this example, the 3 volts is about the lower limit before the diode starts a nonlinear rolloff. Therefore, the 3.16 ratio simply indicates the 10 dB attenuator characteristic. As the output voltage is decreased, the ratio will increase; the difference indicates the diode nonlinearity.

Fig. 3 shows a plot of a number of these measurements, with some similar 70-cm measurements for confirming that there are no discrepancies between the low frequency and the 70-cm data. The 5% differences are within measurement error. The easy-to-use table contains the same data. Other 1N34As show reasonable consistency of data. I selected five other diodes measuring 5 megohms or more back resistance and compared them in the dummy-load/detector circuit. All six were compared with the reference diode output adjusted to 0.1 volts. There was only a 10% difference between the low and high values. With 0.5 volt output, the difference was 4%, and with 3 volts, it was less than 1%.

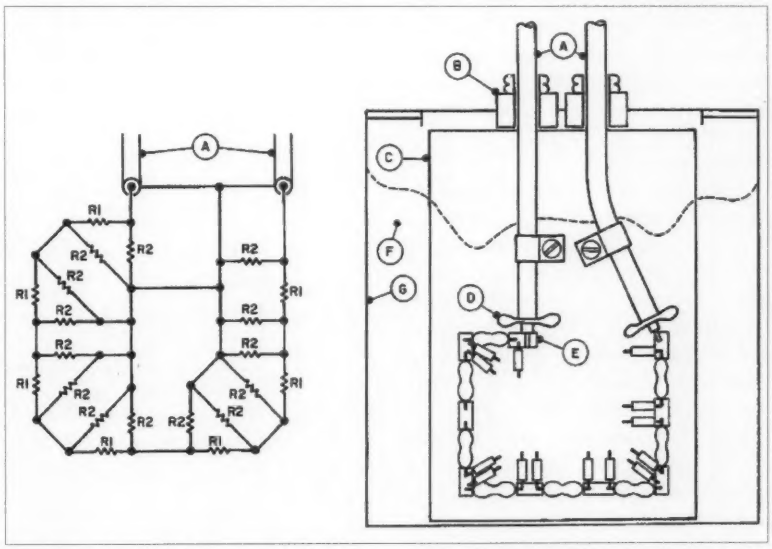

Fig. 2. Schematic and layout of the 10 dB attenuator. R1, 10 ohm 1/2W (7); R2, 1k 1/4W (14). A. Input/Output, 3' RG-58/U. B. Cable bushing, 1/4" clearance hole (I use shaft bushings from old potentiometers). C.Component mounting board, 3-1/2" x 2-3/8" x 1/16" PCB. D. Fan out end cable braid, twist in two segments, solder to PCB with minimum lead lengths. E. Component tie-down pads (9), double thickness glass-epoxy PCB, 1/4" x 1/8" x 1/8.S Pieces cemented together and into position with clear household cement (Elmer's®). F. Coolant, household wax (paraffin). Fill container with melted wax to a quarter-inch from the top. To melt wax, insert the container in hot water (about 200° F). G. Container, one-pint paint can.

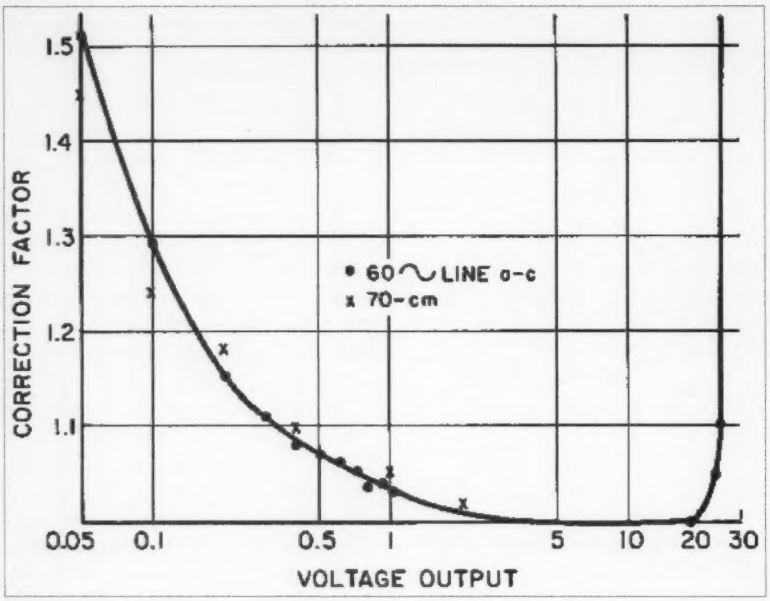

Fig. 3. Diode linearity characteristics (also see Table 1).

The remaining task is to calibrate the dummy-load/detector output as a function of input power. I used a thermal calibration device that's calibrated at a particular power level, then replaced with the dummy-load/detector for a one-point calibration using the identical input power level. The thermal assembly (see Fig. 4) is simply two parallel 100-ohm, 1/4-watt resistors with a thermistor in thermal conduct with the resistors. The layout minimizes thermal mass so that the resistor thermal power results in a relatively rapid temperature gradient.

Testing the device with the SWR directional coupler confirms an SWR of less than 1.1:1. It's first calibrated with DC power input. First, a foam cup is placed over the assembly to prevent effects from possible variable air disturbances. Then power is applied and the thermistor resistance is noted at one-, two-, and three-minute intervals. The resulting thermistor temperature gradient is unique for a particular power input. The assembly can be cooled off to a predetermined reference temperature (near room temperature) in about the same time required for the power-on calibration run by using a forced-air blower. The assembly is calibrated with DC power in increments of 0.25 watts up to 2 watts. See the plot in Fig. 5. Repeated measurements indicate excellent data consistency.

The dummy-load/readout was calibrated using three levels of power: 0.5, 1.0, and 2.0 watts at both 70 cm and 2 meters. From this data, a k value was established for

$$P = \frac{(kE)^2}{50}$$

The k value turned out to be 1.0 at 70 cm and 0.94 at 2 meters, indicating the blackbody/readout assembly has an attenuation at 70 cm. That's 0.5 dB greater than at 2 meters.

To confirm reasonable thermal calibrator performance, I calculated the 2-watt power level with the peak reading from the dummy-load/detector, a 0.707 RMS conversion, and the calculated attenuation of the blackbody circuit (2.1 dB). This calculated power level was 1.0 dB higher at 70 cm and 0.4 dB higher at 2 meters, compared to the thermal calibration method. Such loss factors in with the dummy-load circuit are considered reasonable. As an example, 0.3 dB of this loss at 70 cm can be attributed to the RG-58/U interconnecting cables. Much larger losses would have indicated an input having spurious responses.

You may be thinking: Is this exercise really worthwhile? So I have an SWR of 1.5; calculations show that this will only cause a measurement error of 4%. However, the calculation assumes the effective load, which in this case is 33 ohms (capacitive loading from the diode). It's a common error to assume that the loading stays at 50 ohms. The indicated power level will be 0.64 of the actual power instead of the 0.96 when using the proper load.

Once having the dummy-load/detector assembly calibrated versus a sine wave RMS input, purity of an unknown input can be roughly determined. For example, an input having spurs will indicate an abnormally greater output on the dummy-load/detector compared to the same input calibrated with the thermal

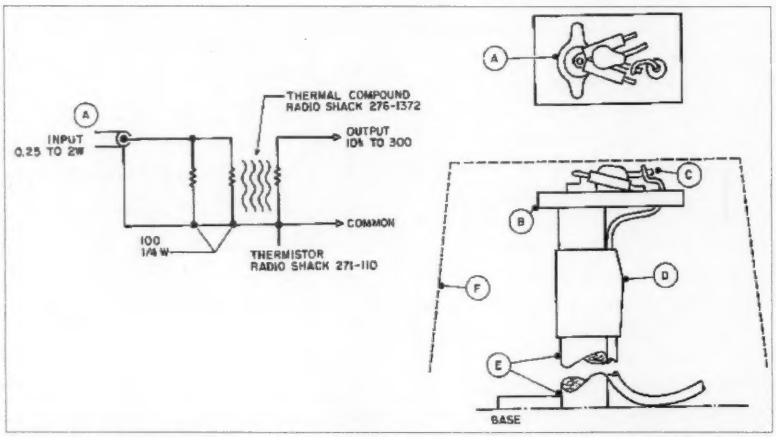

Fig. 4. Schematic and layout of the thermal calibrator. A. Input. 2' RG-58/U. Fan out braid on connecting end, solder to PCB with zero lead length. B. Base, 5/8" x 3/8" x 1/16" PCB. C. Thermistor lead cut short and soldered to a #30 enamel wire. PCB feedthrough hole reamed out with a large drill to avoid shorting to the foil. D. #30 wire connected to a larger size hook-up wire. Fastened to the RG-58/U with tape. E. RG-58/U is fastened to a 6" x 1/4" wooden dowel with tape (maintains the assembly in a vertical position). F. Foam cup is placed over the assembly during the calibration run (avoids air disturbances).

Pico-J rolls up and hides in his 4-ounce pocket-sized holder, waiting like the Genie in a bottle till you need full-quieting signal pouch.
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device. The spurs are a good example because they often greatly increase the diode output reading while the thermal power contribution is insignificant.

I'll admit it's hard to get excited about do-it-yourself hardware these days. It's difficult to compete with compact store-bought equipment having all those attractive knobs and buttons. However, I place measurement in a separate category. First, the hardware can be simple. Second, making it yourself forces you to get into the basic engineering underlying the measurement. Taking a measurement using the fundamentals is satisfying, since you end up understanding what is really going on. 73

Output (Volts)		Correct Factor
0.05	x	1.51
0.1	x	1.29
0.2	x	1.15
0.3	x	1.11
0.4	x	1.08
0.5	x	1.07
0.7	x	1.05
1	x	1.03
2	x	1.01
3	x	1.00
18	x	1.00
23	x	1.05

***Table 1.** Diode Linearity*

LETTERS

Continued from page 31

John Thompson N3KBS. In hopes that you will personally read this letter I want you to know that your October editorial slapped me in the face and said, "Wake up, stupid!" You couldn't have written to me any better if you had mailed a letter to my house. I've ended selling TVs, stereos, and computers at Montgomery Ward and have stopped crying about the lack of opportunity and have decided to make something happen. I've started fixing computers and gadgets and have been successful enough to finance a vacation to Arizona. I've enjoyed several of the books you've recommended. I'm wondering why there hasn't been more use of 900 MHz, which has a lot of room and potential. Thanks for *73*, it's the only ham magazine I've found worth reading. Oh yes, I'm working on losing that extra weight.

Yes, I read my mail. And answer most of it. John, you're right about 900 MHz, I'd love to see a bunch of articles on stuff for that band. . . Wayne.)

Ken Payton KB5ROV. In your editorials you often request letters from your readers letting you know what we have been doing with our time. I find your editorials very interesting and enjoyable because you share your research with your readers and invite us all to join you in reading the same books to gain insight into some subject. I have taken you up on your challenge a few times and am happy to say that I have learned a lot and have had a lot of fun that otherwise I would have missed. For instance: From *Cross Currents*, my wife and I no longer sleep with the electric blanket plugged in. We now use it to warm the bed then unplug it for sleeping. We both feel better for doing this than we thought possible. We have become interested in using magnets for health improvement offered by a company in California. We use some of the magnetic products with positive results. From your *Aids Info* booklet I have built the circuit and we both use it on a regular basis. We use it before going to sleep and find that we rest better. My wife suffers from rather severe cramps at times and has learned that by using this device they are greatly reduced. I have shared your booklet with other people, but have not received any feedback as to whether they use the device. From *Hydrogen Peroxide, Medical Miracle*, I have learned how to cure the common cold. This

Continued on page 51

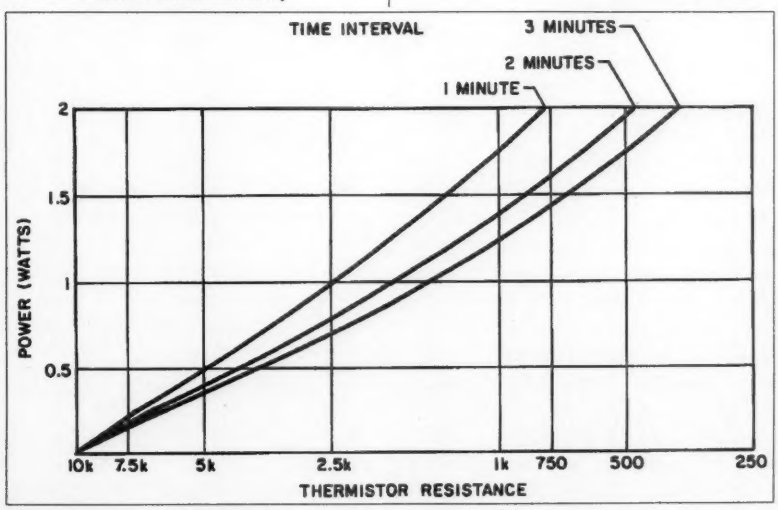

***Fig. 5.** Thermal device calibration.*

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Also included is a new chapter showing how you can use transistors to replace hard-to-find vacuum tubes. You'll even see the circuit that was lashed together on a table top one night using junk box parts, a hair curler and alligator clips. Attached to an antenna strung across the basement ceiling and a 9 volt battery, signals started **POPPING** in like crazy. In a couple of minutes an urgent message from a ship's captain off Seattle over 1500 miles away was heard asking for a navigator to help him through shallow water!

These small regenerative receivers are extremely simple, but do they ever perform! This is a must book for the experimenter, the survivalist who is concerned about basic communication, shortwave listeners, ham radio operators who collect old receivers, and just about anyone interested in old-time radio.

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Ham stations come in all sizes from QRPp to QRO, and most hams like to know just how many milliwatts or hundreds of watts are coming out of their rigs. Until now there has never been a simple, accurate RF wattmeter that is perfect for all legal power levels. The instrument described here will solve all your RF power output requirements, regardless of your power level. Even if you change rigs, going from QRP to QRO or vice versa, you will never need another RF wattmeter.

This wattmeter measures RF power into a 50-ohm resistive load from 100 milliwatts to 1,500 watts in four decade ranges which overlap over 33%, so you'll always know the best range to choose.It can be left in the coax line from your transmitter at all times. It will not affect the impedance of either your receiver or your transmitter. It requires only a small fraction of one percent of your RF output power for operation at any legal power level.

It was designed to use only standard, common components, and can probably be constructed entirely from the contents of most junk boxes and the normal resistors and capacitors most hams keep on hand (or which can be purchased inexpensively from many mail order parts dealers or, for even less, from local hams or at hamfest flea markets).

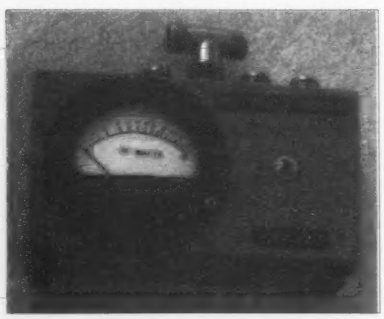

***Photo A.** KB4ZGC's average/peak reading RF wattmeter.*

This instrument is very simple. It's easy to construct in a few hours, very easy to calibrate with a 9-volt battery, potentiometer and DMM, and using it is as simple as glancing at the indication on its meter.

The four power measurement ranges are: 100 mW to 1.5 W; 1 W to 15 W; 10 W to 150 W; and 100 W to 1,500 W. A toggle switch, the only control, allows a choice of average or peak power indication. (Average—actually RMS—power is key-down constant carrier, the actual amount of RF your rig produces. Peak power is that caused by voice peaks on AM or SSB.)

As designed, accuracy is ± 1%, ± the accuracy with which you calibrate the new scale on the meter used. Because the scale is hand calibrated, the normal ± 2% error of normal meter movements is eliminated. Operation is accurate from 1.8 to 30 MHz. It may also be useful through 6 and 2 meters, but I was unable to test on these frequencies.

Circuit Description

Each RF power range has its own coaxial connector: J1-1.5 W; J2-15 W; J3-150 W; J4-1,500 W. A coaxial tee connects the wattmeter in shunt with the coaxial line between the transmitter and the load, which must be 50 ohms resistive if accuracy is to be maintained. One arm of the tee connects to the transmitter, and the other connects to the load.

With switch S1 at AV (average) and the transmitter producing an A1 carrier, the power output delivered to the 50-ohm load is displayed on the meter. The AV position of S1 can be used on all modes.

With switch S1 at PK (peak) while speaking into the microphone of an AM or SSB transmitter, the needle of meter M1 will follow voice power and indicate peak power on voice peaks. The time constant for the peak power mode is approximately 1.9 seconds. Increasing or decreasing the value of capacitor C1 will increase or decrease the time constant, respectively. The resistance of meter Ml, plus meter multiplier resistors Rl and R2, in conjunction with the capacitance of C1, establish the time constant.

With an RF input to Jl between 100 milliwatts and 1.5 watts, the RF is rectified by germanium diode D1, filtered by C2, and the resulting DC voltage is applied through R1 and R2 in series to meter M1, which indicates the level of RF power applied to the load.

With greater RF power applied to the load, using any of the remaining coax input connectors (J2, J3, J4 as appropriate), the RF is divided by a ± 1% resistive divider, sampled and rectified at the tap on the divider, filtered by C2/C3, and applied through R1 and R2 to meter M1, as described in the preceding paragraph.

Construction

This instrument was carefully designed to use all standard parts values, which saves cost, time and one's temper. Using a digital ohmmeter for greatest accuracy, begin measuring your stock of 1/4 W 5% resistors and select those which measure to within ± 1% of the marked value. All resistors except R7 are 1/4 W.

R7 is specified in the Parts List as 1/2 or 1 watt, ± 1%. This resistor will be called upon to dissipate approximately

Continued on page 41

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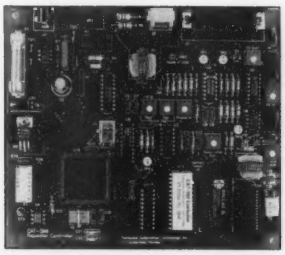

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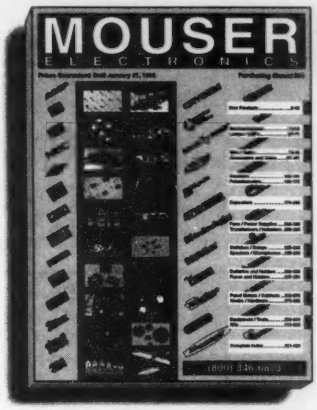

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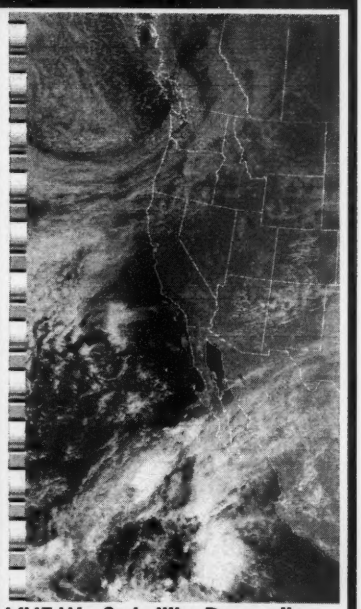

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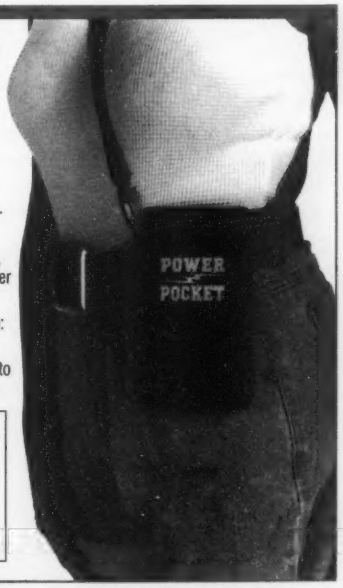

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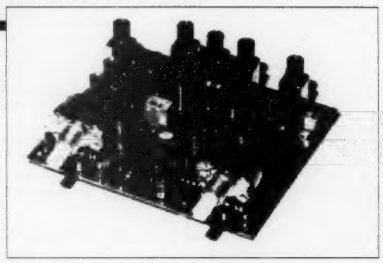

Larry Antonuk WB9RRT
Box 452
Marlborough NH 03455

Practically everyone has heard some version of the story. Two hams have hiked up to the top of Mount Something-or-Other, and are viewing all of the impressive towers and antennas at the commercial radio site. The first ham whips out his new Whiz-Bang 2000, a fully synthesized, multiband wonder the size of a cigarette pack. He brings up the 2m repeater back home, and calls his wife on the autopatch to let her know they made the trip OK.

As he begins the conversation, he finds that his wife's audio is choppy, and whole chunks are being lost out of her side of the QSO. Thinking that something must be wrong with the home repeater, the second ham pulls his handheld out of the pack—a 15-year-old, single-channel, crystal rig. To the surprise of both the hams, the older handheld hears the repeater audio loud and clear. It now looks like the Whiz-Bang 2000 must have a problem!

Totally dismayed, the first ham continues to listen to the traffic on the home repeater. It continues to be choppy, erratic, and overall lousy—but the old handheld is doing just fine. Later that night the first ham puts both radios on his test bench, and tests their sensitivity with a signal generator. He finds that they both measure exactly the same; if anything, the Whiz-Bang is just a tad "hotter." What gives?

What gives is that it takes more to pull in a signal than just being able to hear the weak one you want to hear; you also need to be able to *not* hear the ones you *don't* want to hear. In the case of our friends on the mountain, the strong signals from the nearby commercial transmitters were *desensitizing* the first ham's receiver. The signals were strong enough to pass right into the mixer circuits of the receiver and simply overwhelm it, making it impossible for the receiver to hear the weaker distant repeater signal. But how come the old "brick" worked when the Whiz-Bang didn't? It worked simply because the older radio had better selectivity than the newer one, which is often the case these days.

Selectivity

Selectivity is just the radio's ability to reject unwanted signals. These interfering signals can cause problems that you hear in the speaker, or they may remain silent, but prevent you from hearing something you do want to hear. The older radio was designed to work on a fixed channel, and had dozens of coils and caps tuned to just that frequency. All of this hardware made up a set of tuned circuits whose sole purpose in life was to keep out unwanted carriers, harmonics, and spurs—both from outside the radio, and from circuits inside the radio itself. Of course, all of the hardware added to the size and weight of the radio, resulting in the nickname of "brick."

These days, if you want to build a radio the size of a cigarette pack, some compromises have to be made. First, if you expect it to tune from one end of the band to the other without retuning the front end, some of those coils and caps will have to be eliminated. There are some tricks that allow the radio to electronically tune itself, but in general, the front ends of most synthesized rigs are "broad as a barn." In addition, if you want the radio to be tiny, don't expect to put any of those big helical filters and triple-tuned RF stages in the thing—they take up too much space. Generally speaking, this describes most synthesized radios today. They have loads of cool features, but often can't stack up in terms of selectivity.

So what do you do if you really must have the best selectivity? For instance, what if our two hams were up on that mountain scouting out a spot for a new repeater. The receiver in the repeater would have to stand up to the same RF beating that caused the Whiz-Bang 2000 to tuck its tail between its legs. One thing that can be done is to convert a commercial rig to the ham bands, if you have the money. A better option might be to check out the new R-100 VHF FM receiver from Hamtronics.

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The R-100 is the latest product in a long line of high quality receivers built by Hamtronics. Boasting a selectivity specification that exceeds that of most ham and commercial receivers on the market, the R-100 is available in the 50, 72, 144, and 220 MHz bands. Designed to replace the R144/R220 and R76 series of receivers, the R-100 utilizes all of the features that have made the previous units such winners—triple-tuned front end filters, crystal and ceramic IF filters, low noise FETs for the RF amp and mixer. In addition, the R-100 features an improved, snappier squelch circuit, as well as new output signals that will allow easier interfacing to various repeater or control applications—low-level squelched audio, discriminator audio, and a COS point.

Continued on page 60

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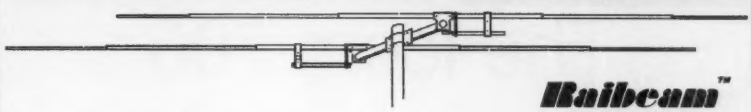

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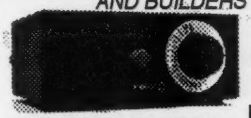

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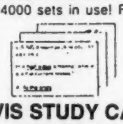

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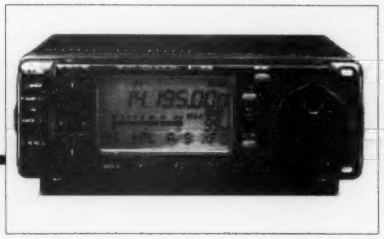
73 Review

The Icom 706 All-Band Transceiver

Reviewed by a very happy user.



Phil Salas AD5X
1517 Creekside Drive
Richardson TX 75081

I recently purchased an Icom IC-706 transceiver to replace my TS-50S for mobile and portable operation. What was wrong with the TS-50S? Absolutely nothing. The TS-50S is a great radio and has provided me many hours of enjoyable "hamming." However, with the sunspots beginning to perk up, I have been seriously considering getting back on 6 meters. I found that a good used 6 meter solid-state all-mode rig would cost me around $500. Therefore, I figured that if I sold my TS-50S and added the $500 the 6 meter rig would cost, I'd have the money for a new IC-706.

The Radio

OK - what is the IC-706? Well, basically it is an all-mode 160-through-2 meter transceiver that is no bigger than most 2 meter FM rigs (dimensions are 6-9/16"W x 2-9/32"H x 9"D, including all projections)! And when I say all-mode, I mean CW, SSB, AM, FM, RTTY. In addition, it will receive wideband FM.

This is pretty neat—you can put it in your car and receive AM and FM broadcast stations, operate 2 meter mobile FM, and operate HF mobile all with the same rig! And, to make it easy to find a place for the IC-706, the front panel detaches from the rest of the radio and can be easily mounted anywhere you've got room. The rest of the radio can be up to 23 feet away (3 meter and 7 meter remote cables are available)!

The IC-706 puts out a full 100 watts from 160 through 6 meters, and 10 watts on 2 meters. The receiver tunes continuously from 300 kHz to 200 MHz. It is also loaded with most of the same features that you normally see in a full-size base HF rig. It includes 101 memories (which is a lot more than my brain has), band and memory scanning, IF shift, RIT, noise blanker, audio speech processor, and an internal keyer.

The keyer can be programmed for left- or right-handed paddle users, a straight key, or you can use the UP/DOWN microphone buttons! I found that I could operate the keyer quite well, with a little practice, using the microphone buttons up to about 20 wpm. You can add one optional narrow filter, so you need to choose between a narrow SSB filter (1.8 kHz), a 500 Hz CW filter, or a 250 Hz CW filter. You can vary the CW offset from 300-900 Hz, select a CW reverse mode, vary keyer speed and weight, and offset the SSB carrier plus or minus 200 Hz to tailor the audio response of the transmitter.

Operating

Operating the IC-706 is not all that difficult, considering the huge number of features and the few controls. Icom did an excellent job of building user-friendly menus and displays for accessing these features. Pressing the DISPLAY button brings up major features, and then the MENU button scrolls through subfeatures of the displays. Once you've been through the instruction book once, you should be able to fully operate the radio, only having to go back to the book infrequently. Basic operation of the radio is very easy. About the only thing you need to know is how to change bands, because the default settings pretty much provide you with what is necessary. Just plug in the microphone or key and go! Now, let's get into a little more detail.

Band changing is done with the TS (Tuning Step) button. The first press of this button illuminates two arrows over the 10 MHz/1 MHz portion of the display. When you turn the tuning knob, the bands will change sequentially up or down (includes 15 MHz for WWV). A second push of the TS button puts a single arrow over the 1 MHz portion of the display and permits you to tune 1 MHz at a time. The next button press lets you tune in 1 kHz increments for rapid movement around a band, and the last press tunes in 10 Hz increments for normal tuning. Normally, you punch TS once, change bands, and then punch it three more times to get you back to normal tuning. The radio beeps every time you push a button, so this is a pretty straight forward operation and quickly becomes automatic.

On transmit, you can meter output power, ALC or SWR, based on a simple menu selection. You use the ALC reading to digitally set the microphone gain from one of the menus. The audio speech processor is easily turned on and off and works very well. The output power is continuously variable from another menu from less than 5 watts to 100 watts. My IC-706 turns down to 3.5 watts. This is great for the QRP enthusiast, though the current consumption of this radio is not what QRP-types are used to. Lots of features mean lots of

Continued on page 60

P-Out	Setting	Current (160m)	Current (6m)
3.5W	L	5.7A	6.0A
5W	1	6.5A	6.7A
10W	2	7.7A	8.0A
20W	3	9A	10A
30W	5	11A	12A
50W	6	12.7A	5A
100W	H	18A	20A

Table 1.

Every Ham's Average/Peak

Continued from page 36

one-half watt during 1,500-watt peaks only, so for all practical purposes a half-watt resistor will suffice. Using a 1-watt ± 1% resistor will remove all doubt for QRO operators.

The size and shape of the enclosure you use, either a commercial or home-brew aluminum box, or one made of printed circuit board stock, will depend on the physical size of the 100 µA meter you use and the space required by the four SO-239 or other RF connectors. I used an LMB-138 aluminum box 6-1/2" wide by 3-1/2" high by 2-1/8" deep because my surplus meter was round, with a diameter of 3-1/2-inches. I had to saw about 3/8" off both meter studs so it would fit within the shallow depth of my enclosure.

The four germanium diodes required (D1, D2, D3, D4) must all have the same type number, but it is not necessary to match them for forward resistance.

New 100 µA meters are far too expensive for most of us to even consider. If you don't own one or can't get one from a local ham or a flea market, you can do as I did. The meter I used is 3-1/2" diameter, round, and came in a "grab bag" of five used meters (no choice) purchased from Fair Radio Sales Co., P.O. Box 1105, Lima, OH 45802-1105, Catalog No. 47-84, $10 plus shipping. Over the past 10 years I have purchased seven of these "grab bag" assortments, and all meters have been high quality, with d'Arsonval movements, some with jeweled bearings, made by Marion, Westinghouse, Simpson, etc. Size varied from 2-1/2" to 6"; round, square and rectangular. All have been removed from equipment and tested before resale. While meter scales are sometimes non-standard, there have always been at least one, and often two, meters with 50 or 100 µA movements. The remaining meters have always had 0-1 mA movements.

Some meters may contain internal multipliers or shunts and sometimes rectifiers, but these are easy to locate and remove. If you have such a meter and are unfamiliar with modifying meters, please refer to my article, "Use Those Surplus Meters," *73 Amateur Radio Today,* January 1992, page 42. You can order photocopies from the publisher if you don't have a set of back issues on the shelf (tsk!). All in all, for $2 you'll have a fine 100 µA meter for your RF wattmeter, and have four more useful meters for future projects.

It will be preferable if all four coaxial connectors are mounted touching each other, either in a line or square. This allows for very short leads for all components carrying RF, extremely important to achieve the design accuracy. There is always some unavoidable RF leakage which will be contained by the enclosure, but which forces a deviation from the calculated resistance values to maintain the accuracy of this instrument.

The four coaxial connectors should be mounted using four sets of 4-40 screws, lock washers and nuts. Be sure to scrape any paint from areas where these connectors are mounted, to assure excellent grounding to the enclosure. Two terminal strips with one ground and one insulated terminal will later be mounted using two of the connector mounting screws, depending upon the arrangement of the connectors.

Wrap a fine wire around both terminals of the meter M1, shorting them together to protect the sensitive movement. Then mount the meter on the panel temporarily. It will be removed for calibration, then replaced and connected into the circuit permanently. Temporarily mounting the meter now ensures there will be no components or wiring which would interfere with the meter case or terminals.

Cut one lead of R3, R5 and R7 to 3/16". Hold the short lead of R3 close to the resistor body with the tip of needle-nose pliers. Melt solder into the center pin of J2. When the solder is molten, insert the short lead of R3 into the molten solder, making certain not to move it while the solder solidifies. This is no place for a cold solder joint!

Repeat this procedure, soldering the short lead of R5 to the center pin of J3, and the short lead of R7 to the center pin of J4.

Now mount the two terminal strips on connector mounting screws, positioning the terminal strips so their terminals are approximately centered below and between J1 and J2, and between J3 and J4. Tighten the mounting hardware, using additional lock washers if required.

Because of the necessity to reduce to the greatest extent possible the chance that any RF can leak off where it isn't

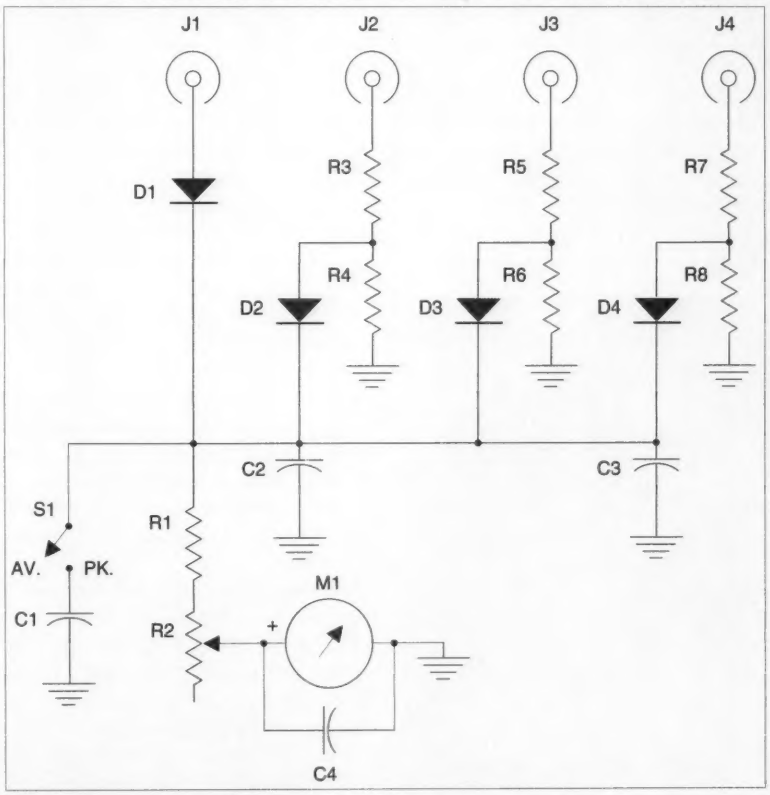


Fig. 1. *Schematic for the RF wattmeter.*

wanted, thus destroying the accuracy of this instrument, connections to the free ends of R3, R5 and R7 must be made "up in the air," spaced away from the enclosure walls and the meter movement. If space requires, J1 can be safely mounted near the meter, but the others should be some distance from the meter.

Now solder one end of R4 to the free end of R3, against the body of both resistors. Clip the end of R4 at this junction but leave the free end of R3 attached. Route the remaining lead of R4 to the ground terminal on the appropriate terminal strip, but do not solder it at this time. Make sure the soldered junction of R3 and R4 is "up in the air" and in the clear. Now, using needlenose pliers to hold the anode of diode D2 close to its body, connect the anode lead to the junction of R3 and R4, and solder. Clip the extending leads of R3 and D2. Route the cathode lead of D2 to the insulated terminal of the strip to which R4 has been connected, but do not solder yet.

Cut the anode lead of D1 to 3/16". Hold this end of the lead in the tip of needlenose pliers. Melt solder in the center pin of J1. When the solder is melted, insert the short anode lead of D1 into the center pin of J1 and hold it steady until the solder has solidified. Continue holding the diode anode lead with the needlenose pliers until the solder joint is cool, to protect the diode from excessive heat.

Route the cathode lead of D1 to the insulated terminal to which the cathode lead of D2 has been connected, but do not solder it yet. Connect a short length of insulated hookup wire to this insulated terminal. Solder this wire and the two diode cathode leads on the insulated terminal using an alligator clip or needlenose pliers on both diode leads to protect them from excessive heat. Connect the other end of this wire to the insulated terminal on the other terminal strip. Solder the lead from R4 on the grounded terminal strip. Solder C2 between the holes on the insulated and grounded terminals. C3 can likewise be soldered between the holes on the two terminals on the other terminal strip at this time.

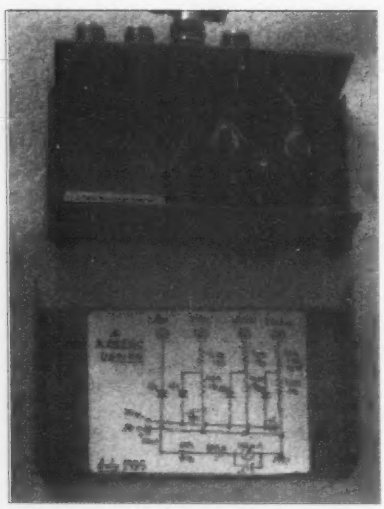


***Photo B.** Inside the RF wattmeter.*

Connect and solder one lead of R6 to the free end of R5, routing the free lead of R6 to the grounded terminal of the other strip, as was described for the circuit connected to J2. Connect the anode lead of D3, holding it with needlenose pliers, to the junction of R5 and R6 as described for D2, and solder. Clip free resistor and diode leads from the R5-R6 junction. Route the diode cathode lead to the insulated terminal of the remaining terminal strip but do not solder.

Connect and solder one lead of R8 to the free end of R7, routing the free lead of R8 to the grounded terminal of the strip where R6 is connected. Solder this connection. Clip off the free excess lead of R8 at its junction with R7. Holding the anode lead of D4 with needlenose pliers, connect and solder to the junction of R7 and R8. Clip off the excess diode lead. Route the cathode lead of D4 to the insulated terminal where the lead from D3 is connected. Connect a short length of insulated hookup wire to this insulated terminal. Using an alligator clip or needlenose pliers on the diode leads, solder this terminal.

Closely inspect all solder joints just made to ensure they are shiny and all connections are solid. If necessary, gently move the three resistor/diode circuits so their junctions are "up in the air" and away from each other and the walls of the enclosure.

Caution: Before any further construction can be accomplished, meter M1 must be calibrated. Refer now to the calibration section following. When calibration has been finished, return to this section to complete the construction.

With calibration completed and the meter reassembled, mount the meter on the panel. Select a small terminal strip with two insulated terminals. Connect R1 between the terminals but do not solder yet. Mount the terminal strip on one of the meter mounting screws, using additional lock washers if required.

Connect the wire leading from the terminal strip which ties all diode cathodes together to one end of R1 and solder. This wire carries only low voltage DC but should be routed away from the resistors carrying RF. Its length is immaterial.

R2 is a trimpot. Because they are made in various configurations it is up to you to determine how to install the one you use. I used a small, square trimpot, single turn, with a side adjustment. I used Krazy Glue® to attach it to the rear surface of the meter.

Solder a length of insulated hookup wire to the free terminal of R1. Solder the other end of the wire to either of the end terminals of R2. Solder another length of wire between the wiper terminal of R2 and the positive terminal of M1. Solder a wire between the negative terminal of M1, to a ground lug mounted on either a meter mounting screw or one of the screws mounting the nearest coax connector. Connect and solder C4 across the terminals of M1.

If you are including the peak reading capability in this instrument, mount switch S1 and capacitor C1. Be certain of the polarity of C1. Connect a short length of insulated hookup wire from the free terminal of S1 to the terminal where R1 and the wire from the diode junctions are connected, and solder.

There are three short tests which should be made before closing the case. Place S1 in the AV position. Attach the 50-ohm dummy load which you normally use in your station to J2. Using a digital ohmmeter, measure the resistance to ground from the junction of R3/D2/R4. Be certain the red (positive) lead goes to this junction. The resistance should be in the vicinity of 2,385 ohms.

Connect the 50-ohm dummy load to J3 and measure from the junction of R5/D3/R6 to ground as described above. The resistance should be in the vicinity of 3,140 ohms.

Connect the 50-ohm dummy load to J4 and measure the resistance from the junction of R7/D4/R8 to ground as described above. The resistance should be in the vicinity of 1,111 ohms.

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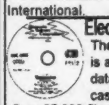

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The resistances just measured bear little relationship to the values of R4, R6 and R8. This is because of the several parallel resistance paths inherent in the design of this instrument. These values are for guidance and are not intended to be exact; merely close. The tolerances of the ± 1% resistors, the forward resistance of diodes, and the exact resistance of the 50-ohm dummy load all affect the resistances just measured.

Calibration

Because the root-mean-square value of an AC voltage (RF) waveform represents the effective voltage across a resistance, this instrument can be easily calibrated with a variable DC voltage. Less than 9 volts is required, so a 9-volt battery and a potentiometer is the simplest calibration source, along with a DMM for accurate voltage measurements. The overall measurement accuracy is greatly affected by the care with which the meter is calibrated by hand.

Remove the meter from its case so you have access to the face. If there is a scale, the numbers and calibration lines can be carefully covered with a product such as Liquid Paper® (used for making corrections in typed material). Use it sparingly, and be careful not to obliterate the arc. Use care not to bend the needle! You may wish to remove the meter face to make this work easier. The face will have to be replaced on the meter before calibration can proceed.

Refer to Figure 2, the calibration setup, and make the connections between a germanium diode, R1, R2, Ml, the calibration potentiometer, DMM and a 9-volt battery.

Set R2 to its maximum resistance, and also set the calibration pot to its minimum resistance with its wiper at the negative end before connecting the battery. You may also use any other DC voltage source handy, including the station power supply, of course.

Table 1 lists the 15 voltages required to calibrate the meter scale between 1 and 15. The more accurately you establish these voltages and the care with which you mark each point on the new meter scale, the greater will be the overall accuracy of this instrument. Although this is of major importance only to QRP and QRPp operation, it will still be nice to know that "What you see is what you get" when you glance at the meter later.

Adjust the calibration pot so the DMM indicates 8.66 volts. Then adjust R2 for a full-scale indication on M1. Mark this "15."

Caution: Do not touch the setting of R2 after this initial calibration is made. Adjust the calibration pot so the DMM indicates 8.37 volts. Mark the meter needle location on the scale "14."

Referring to Table 1, continue marking calibration points on the meter scale with the numbers equivalent to the calibration voltages listed.

It will be preferable if you merely make tick marks on the meter scale during calibration. You can extend them into short lines and add the numbers when calibration is complete. The larger the physical size of your meter, the easier and more accurate will be the calibrations. Because the scale is nonlinear, the higher power calibrations will be more crowded than those at the lower end. Also, only about 2/3 of the available scale is calibrated so that 1-1/2 decades can be covered on each range, providing the desirable overlap between ranges.

Because "1" on the 1.5-watt scale represents 100 mW, QRPp operators may be tempted to calibrate their scale below this point. However, this is not recommended because of the approach of the low RF voltage level to that of the germanium diode conduction knee. Serious inaccuracies could result.

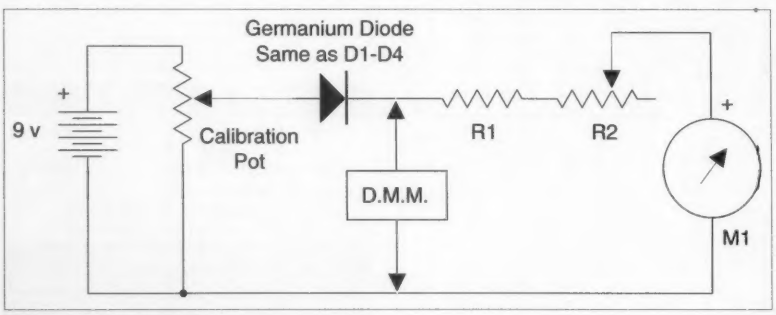

Fig. 2. Calibration setup.

Operation

The operation of this RF wattmeter is simple. Connect a coaxial tee adapter to the appropriate connector on the wattmeter. Connect the transmitter output to one leg of the tee, and a 50-ohm dummy load sufficiently robust to dissipate suspected transmitter power output to the other leg safely.

Key the transmitter and the power output will be indicated by the wattmeter. With an antenna or an antenna tuner and antenna presenting an SWR of 1:1 connected replacing the dummy load, the wattmeter will accurately indicate the output from your transmitter.

For modes other than AM or SSB, S1 will normally be set at AV. The PK position is included to monitor peak power on AM and SSB. With S1 at AV and operating AM or SSB, the wattmeter needle will swing wildly but the peaks indicated are the result of inertia and do not accurately display actual peak power.

Should you inadvertently apply power to this instrument without a 50-ohm resistive load connected, you might blow a diode, and you might bend the needle in a worst case, but no other damage should result. So, make certain you connect to the proper connector on the wattmeter. If you are unsure of the power output from a particular transmitter, start at J4 and work your way down.

Comments

Although the resistance tolerances of ± 1% are specified for resistors in the RF portions of the circuit for greatest accuracy, especially at the QRP range of 1-15 watts, the QRPp accuracy is totally a function of the accuracy of the calibration voltages and the care with which the meter scale was marked. The inaccuracies resulting from the use of 2% or even 5% resistors on the 150- and 1,500-watt ranges are much less important. A watt or two at these power levels is inconsequential, so you can fudge a little on these two highest ranges without being very concerned.

Peak power indications can be made usefully only on those modes where the output power actually varies. It is of no

Continued on page 57

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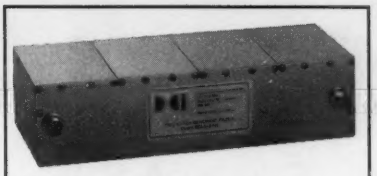

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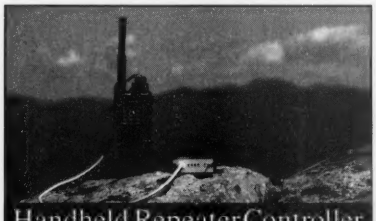

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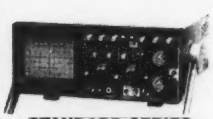

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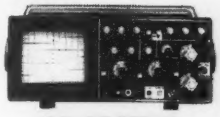

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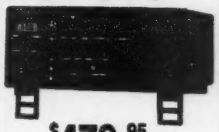

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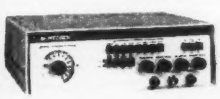

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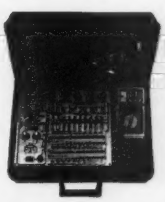

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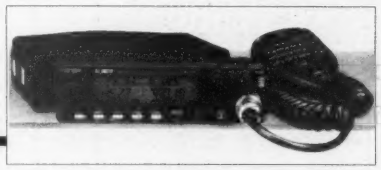

Gordon West WB6NOA
2414 College Drive
Costa Mesa CA 92626

What could Alinco Electronics do to top what the rival "big three" have done with a detachable-head, 2 meter/440 MHz, mobile transceiver? It's tough to surpass all of those great features already found in the Kenwood, Yaesu, and Icom versions of this product. The new Alinco DR-610T has these same features, too:

- •High power, 40 watts-50 watts on 2 meter VHF
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- •Full frequency receive coverage VHF, 108 MHz-173 MHz
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- •Time-out timer
- •Phone patch auto dialer

However, the Alinco DR-610T may top the competition when it comes to an extremely important feature for ham operators wanting maximum value at the best price—the DR-610T was seen selling for at least $85 less than comparable Kenwood, Yaesu, Icom, and Standard Radio dual-band transceivers. The DR-610T is also the first dual-band transceiver with built-in LITZ, "long tone zero." This function, described in a *QST* article several months ago, may soon be one of the best ways to signal for help on simplex or repeater duplex frequencies late at night when the control operators may have their equipment in the automatic unmonitored mode. The LITZ signal is accomplished by holding the "zero" DTMF button down on "transmit" for more than three seconds to alert another Alinco DR-610T, or any other system with LITZ capability, that an important message is on frequency. When a DR-610T receives a LITZ signal, it will sound a loud SOS CW alerting tone, regardless of the speaker's volume setting, and flash a "LIT" on the LCD display to alert you that an incoming three-second zero has been detected. This feature allows a control operator and all hams to monitor (silently) a specific frequency at night for an "SOS" LITZ call.

"The built-in LITZ feature allows a control operator and all hams to monitor (silently) a specific frequency at night for an "SOS" LITZ call."

Alinco President Mark Morisato describes the DR-610T as "designed for convenience, with advanced operating circuitry already built in." He is describing the LITZ function, built-in duplexer, digital squelch circuitry, and capabilities for adding an EJ-23U memory chip to program a whopping 240 channels in fail-safe memory. Dave Chernow KE6TFO, sales coordinator for Alinco, adds, "Our DR-610T is an upgraded success based on our DR-600, which continues to be one of the hottest-selling dual-band mobile/base transceivers throughout the country."

The DR-610T is shipped with one of the most complete large-format instruction manuals that I have seen for some time. Read the manual before turning on the equipment—this will save you agonizing minutes when you get into keystrokes that appear to freeze channel-changing capabilities. The set is no more complex to operate than any other brand of transceiver but, as with all new equipment, you *must* read the first couple of pages to get a feel for how you program frequencies and begin to memorize simple and duplex channels.

The Alinco DR-610T wires into 12 volts, and needs 12 amps for full power output. Yes, you could run it straight off a cigarette lighter plug, but we measured a 1-1/2 volt drop, and this decreases VHF/UHF power output by more than 10 watts. If you want to squeeze every last drop out of your new set, wire it directly to the battery, making sure to fuse both the positive and negative leads within an inch of the battery connection. Alinco provides you with the fuses and fuse holders at the ends of the red and black wires.

The DR-610T has a built-in duplexer, and this simplifies the hookup to your dual-band antenna. Whether you are running the equipment mobile or base, a single coax feed makes for quick hookup to the single antenna system. Few of us use separate 2 meter and 440 MHz antennas, so run your coax, hook into the antenna system, and you are all set.

Optional Features

If you're going to remote-mount the head, you will want to buy the EDS-2 front panel remote cable kit, and the EBC-8 front panel bracket. You could

also order the EDS-1 junction box that allows the microphone to hook up to something beneath your seat, rather than off the remote head that you may want to put over the rearview mirror. Many new vehicles come with capabilities for running the remote up high, and the junction box keeps the microphone from dangling in front of you.

I would also encourage you to purchase the optional tone decode squelch unit EG-24U, which would allow you to radio-control the operation of your equipment from another handheld transceiver. This is a handy feature if you regularly run your mobile unit in the crossband duplex mode and want to radio-control it on or off, or to change frequencies by remote. Whenever running equipment in the dual-band crossband mode, check with local frequency coordinators to ensure that you are using this advanced feature properly, and remember that controlling a "repeater" must be done on frequencies other than its normal input.

And as long as you are inside the set, you might as well purchase and plug in EG-23U, the additional memory unit that expands your 120 channels to 240 channels. Now you can program every living repeater, aeronautical receive channel, public safety channel, weather channel, police and fire channel, and just about anything else you want, into memory so you never need to carry that little black memory book with you again!

The full-featured EMS-12 microphone is shipped with the USA model. No longer must you buy a more elaborate microphone to go along with all of the dual-band capabilities for which you are programming the set. The microphone is relatively lightweight and has its own unique Alinco feel. I have friends who have tried out the equipment and have immediately fallen in love with it.

Operation

When everything is hooked up, turn on the power by depressing the power button located just above the mike jack. Like all dual-band transceivers, it comes up in VFO mode at 145 MHz for 2 meters, and 445 MHz for the 70 cm band. There is nothing loaded into memory. You know, with CPU technology and cloning, I wish that incoming transceivers would have the US repeater band plan stored. Which manufacturer will be first to pre-load common popular repeater pairs so the new operator can go into memory and start receiving radio excitement on 2 meters and 440?

"When it comes to group pager modes, selective calling, all calling, and group calling, Alinco has moved well ahead of other manufacturers in providing documentation and explanation in their user manual."

Unlike the Yaesu FT-8500, the new Alinco has no cloning capabilities nor does it offer alphanumerics user-programmable on the display. But it is not as expensive as the Yaesu set, either!

The LCD display on the Alinco looks very good, and is easily viewed from the top, bottom, and sides. Volume controls for both VHF and UHF are side-by-side, and you have plenty of volume output for use in noisy vehicles. The squelch control is logically concentric to the volume controls, and squelch action is normal for this type of transceiver. Signals just in and out of squelch will chatter, and this is typical of "hard squelch" found in almost all equipment except for some Icom transceivers that use a new soft squelch feature.

You select VHF or UHF by pushing the volume control in for that particular band. You can dial the frequency from the front panel knob, or push the microphone up/down keys, or program the frequency from the microphone. The big channel-changing knob on the front has a logical push capability to enable 1 MHz quick-steps. This allows you to rapidly go from ham to public service without having to fish around to find the 1 MHz button—a good feature.

The transmit power was 52 watts on VHF into a perfect match, and 37 watts on UHF. A small fan comes on immediately to keep things cool. An LCD bar graph illustrates high power, medium power, and low power. However, the LCD graphs don't change much with a major antenna mismatch. On older single-band and dual-band transceivers you could always tell a bad match by a power output indication that never makes it to the top. It would probably be wise to check your VSWR initially with an external meter before pouring on the coal.

Dialing in the VFO mode is a snap. Getting down to the AM aircraft band requires just a couple of button pushes. We found half-microvolt sensitivity from aircraft band all the way up through 170 MHz on VHF, and one-quarter-microvolt sensitivity on UHF band limits, too. We drove the unit through "intermod alley," and it was no worse than other dual-band mobiles we have tried. This is a major improvement over the Alinco 599, which had such a hot receiver that it was prone to intermod. A built-in attenuator of about 20 dB can be placed in either, or both, VHF and UHF bands when you have plenty of signal to work with and you want to knock out intermod. A very small "ATT" icon appears above the frequency display to show the attenuator turned on.

The Alinco DR-610T features 120 memory channels plus split channels, call channels, and scan edge channels. They are divided into five banks. Bank A, B, and C memory channels are used for both VHF or UHF. The same memory channel can be recalled for both VHF and UHF. Thirty channels are dedicated to VHF, 30 channels for UHF, and 20 per Bank A, B, and C (total of 60) can share bands. The shared bank is an advanced feature, and most hams will start off with either VHF or UHF by themselves. To memorize a VFO frequency in a specific memory, you would push the "function" button, then the bank button, then dial up the frequency you want, and push the "MW" button while the function symbol is showing. While this sounds a bit confusing, it begins to make sense after you have programmed a couple of channels. I would say it's no harder to program this set than any of the others, once you read the manual and follow the steps precisely.

We tried the "spectrum analysis" feature, also found on an Alinco handheld, and indeed little LCD bar graphs go up and down as adjacent-channel and on-channel activity come up and go away. But it's not real-time, and there is an annoying "hiccup" each time the unit samples the MPU looking to see what's happening on other frequencies or channels. I would view the spectral display as a specialized feature that only a few hams will truly take advantage of. It's not the same as looking at a spectrum analyzer.

The Alinco goes into single-band transceive easily, eliminating the band you don't want showing on the screen. This is a handy way to make programming easy for you when you're on the road and you're just listening to a single band. When checking repeaters for input activity, you will feel for the second button in on the bottom (the reverse button), and give it a push. While this is a great feature, I wish they had put the reverse button as a double push of the main tuning button.

The CTCSS built-in encoder was straightforward. However, why no decoder? The new little Radio Shack single-band mobile offers both encode and decode. Other manufacturers leave out decode, too, so it'll probably be awhile before we get encode/decode as a built-in feature.

The unit can easily go into the "set mode" to allow the following menu selections: beep tone volume, bell audio on/off, speaker on/off, display back lighting, time-out timer, channel scope receive interval, channel scope kilohertz width, DTMF first-digit delay, DTMF burst and pause interval, LITZ on/off, monitor function on/off, and S-meter squelch on/off.

Crossband capabilities? Yes—a great feature. Unlike earlier models that required internal modification, the new DR-610T has full crossband capabilities. You would only use crossband with the optional CTCSS decoder installed and set. If you don't, random noise could trigger your crossband receiver to unsquelch, causing the transmitter to lock on, and a signal containing nothing but hash to go out on the air. If you only use crossband duplex with CTCSS decode, the only thing that will trigger your transmitter is a proper signal with a proper tone. It would also be good to enable the time-out timer to cycle the whole system down in case something should hang up the transmitter.

If you have the built-in tone decode unit, you can control your transceiver using a DTMF companion hand-held or mobile set. Number 45 starts accepting remote-control commands, and number 54 stops the remote-control commands. D1 turns the crossband repeater on, and D4 turns the repeater off. You can allow direct frequency entry up to five or six digits in the external remote-control mode when working frequencies or memory channels in crossband. We recommend that you contact your local VHF and UHF frequency coordinators before enabling this unit as a base station in the crossband remote.

Packet operation of the Alinco DR-610T can be a normal TNC at 1200 bps, with an input of 2.7k ohms and a normal modulation input of 10 millivolts peak to peak. For 9600 baud, the input is 10k ohms at 2 volts peak to peak with a TNC that can handle this faster rate. The Alinco crew offers several pages on typical packet operation hookups, and we judged the diagrams as very good.

When it comes to group pager modes, selective calling, all calling, and group calling, Alinco has moved well ahead of other manufacturers in providing documentation and explanation in their user manual. Few hams ever use the group pager mode, though it's a very handy feature to alert one person, groups of 10, or groups of 100 that something is happening out there on the airwaves. The pager mode requires the optional tone unit for decoding, but the auto-dial mode that is part of the basic unit allows encoding any tones that you wish to send out. There are seven digits in the total group pager mode. Wild-card tones can alert many stations at the same time of incoming traffic. I suggest that emergency communications team leaders help everyone set up for this very important mode for disaster preparedness. Most sets have this group-call capability with the optional decode chip, and it is indeed a very functional—albeit complicated— operation.

The DR-610T is best suited for small-vehicle use. You would want that detachable head right in front of you, and you may wish to remote-connect the microphone so you can get your big fingers around those very tiny volume and squelch knobs. The tiny buttons and the tiny volume and squelch knobs have almost exceeded the demands of miniaturization for most of our radio users. Several users mentioned that the buttons and knobs were too small for heavy-duty mobile use. However, the DR-610T's performance was extremely impressive when it came to solid power output, cool-running transmitter, and plenty of receive audio for noisy vehicles. The display was relatively small, but very viewable both day and night as it is back-lit.

If United States amateurs embrace LITZ, it will be a boon for travelers, who will be able to signal for help or roadside assistance by simply holding down the zero button while keying the mike for more than three seconds.

Best of all, the new Alinco DR-610T is probably one of the lowest-priced dual-band mobile transceivers, with more than enough features and memory channels than you'll probably ever use. But it's nice to know you have a transceiver that will grow with how you plan to use it. For the best deal, get those internal chips at the same time you purchase your new set. Plug them in, and get set for a power-packed dual-band transceiver that is just as much at home at your base station as it is under the dash or above the rearview mirror in your car. I liked the Alinco DR-610T. 73

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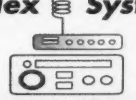

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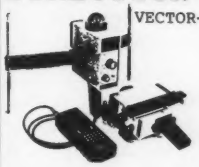

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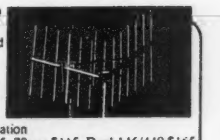

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73 Review

How About a 2W 40m Transceiver Kit?

Build a "fits-in-your-pocket" 40m QRP transceiver.

***Photo B.** The completed rig.*

Jeff M. Gold AC4HF
1751 Dry Creek Road
Cookeville TN 38501

Club Project

The Wilderness Radio NorCal 40A was originally a club project of the Northern California QRP club. The club wanted a project that would really spark interest in QRP. Jim Cates WA6GER, Doug Hendricks KI6DS, and Wayne Burdick N6KR, the club's organizers, got together to discuss a possible club project. Their philosophy was that if they could come up with a small QRP CW transceiver that was easy enough for the new builder, yet performed well on the air, they would have a new breed of low power enthusiasts. The word about the new kit spread rapidly in QRP circuits and the newly formed NorCal club grew to over 1,500 members in just over two years. The success and growth of the club can, in a great part, be attributed to the club projects. The club also publishes an excellent magazine called *QRPp*. Bob Dyer KD6VIO recently started Wilderness Radio to offer the NorCal 40 commercially to all those who missed out on the club's offering. Bob is now offering this kit and other excellent NorCal QRP kits.

How QRP Is It?

Wayne Burdick N6KR designed the kit for the club. The NorCal 40 was designed to be a compact 40 meter CW transceiver optimized for portable, battery-powered operation. The rig has very low receive current drain, typically only about 15 mA. It is also very thrifty on transmit. The rig has RIT (receive incremental tuning), very smooth and quiet transmit/receiver switching, a very pleasant sidetone, and the power can be adjusted internally from almost nothing to a maximum of between 1.8 and 3.0 watts, depending upon the supply voltage.

I have had many new hams ask for advice on what type of kit to start with, so I've established some basics that are the key to any successful venture into this area. It should be easy and fun to build. This means the directions have to be clear and easy to follow. The printed circuit board needs to be of high quality and clearly silk-screened so you know which parts go where. I prefer plated-through solder-masked boards. They are much easier to solder; the solder joints are stronger and the solder mask helps eliminate one of the two major building errors that new kit builders frequently run into: putting the wrong part in the wrong place or ending up with a solder bridge on the board. (A solder bridge is where you accidentally get solder to connect two parts of the board that aren't supposed to be connected.) Clear instructions and a good silk-screen help eliminate the wrong part problem and the solder mask helps eliminate the solder bridge problem. The Wilderness Radio kit has a top-of-the-line, nicely silk-screened, plated-through, solder-masked printed circuit board and good instructions.

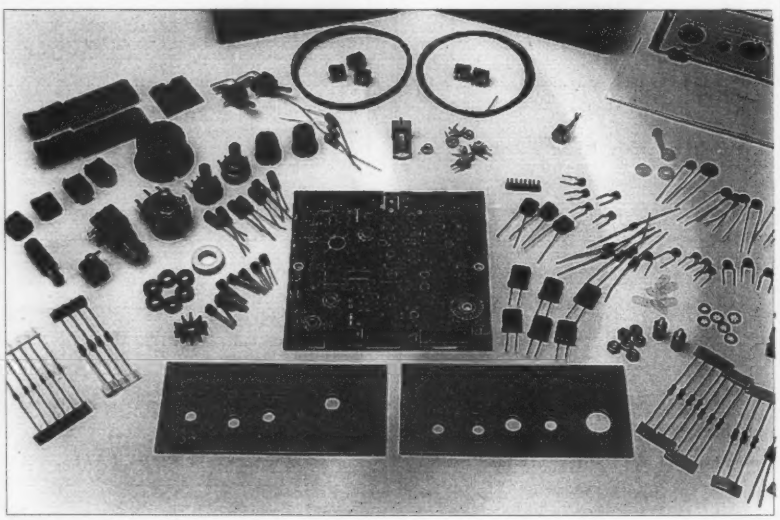


***Photo A.** The NorCal 40A before assembly.*

The next area that new kit builders are concerned with is tuning up the rig. This kit was designed to be easy to align and it can be done with no test equipment. If you don't have test equipment, such as an oscilloscope and frequency counter, you can use an HF transceiver.

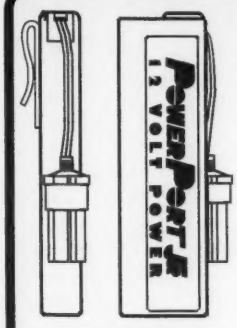
VFO-The Way To Go

New builders are usually looking for inexpensive kits. While separate transmitter and receiver kits are available, if new builders don't choose kits that perform well they can easily get discouraged. I always recommend a transceiver over separate transmitter/receiver combinations. I also recommend a superhet receiver with a VFO rather than a crystal-controlled kit. It may be fun for a

LETTERS
Continued from page 35

really works! From *Amazing Mind Machines You Can Build,* I have improved my use of the Pendulum and had a lot of fun with it and the Energy Wheel. I then built the Wishing Machine, using the block diagram and a Radio Shack Mini Amplified Speaker #277-1008C as the active circuit. By following the author's suggestions I have helped a good friend who is suffering from prostate cancer. He is taking chemotherapy, but is not experiencing any of the usual illness that is associated with this treatment. His improvement since using the Wishing Machine has been nothing short of fantastic. I have enjoyed studying from these books and plan to add to my library on a regular basis. Keep up the good work. There are many of us who really enjoy your editorials and benefit greatly. Thanks.

You're welcome! But Ken, how about letting me know what books you've found that I might enjoy? . . . Wayne.)



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Richard Harrison KB5WZI. My father-in-law, Phil Rand W1DBM, recently became a Silent Key. Phil was born in 1906, the son of a founder of Remington Rand Corp. He was a registered engineer, inventor and prolific author. For instance, among his WWII contributions was a TV-guided bomb. An avid ham, his first *QST* articles appeared in 1930. He finished his final

Continued on page 61

short while to operate some of these kits, but I found the fun ran out quickly when I was stuck on a single frequency.

The NorCal 40A has a superhet single-signal design receiver which has excellent sensitivity (it hears the signals if they are there), selectivity (it can separate the signals), good audio output, and an AGC circuit (automatic gain control to attenuate very strong signals and keep the audio more constant). The VFO (variable frequency oscillator) is very stable.

Physically, the rig is very small (2.25" H x 4.5" W x 4.5" D). One double-sided, screened, and plated-through PC board is used. There is *no* chassis wiring: All controls and connectors and even the case parts themselves mount directly to the board, resulting in a much easier final building stage. The custom .060 case is extremely rugged and is designed to allow the top and bottom to be removed easily for alignment or testing. Long-life plastic latches are provided on the top so no screwdriver is needed to access internal controls. If you like to play with the tune-up every once in a while, or just show off your work, this is great. The rig is small enough (one of the smallest on the market) to fit easily in a backpack. I power mine with a pair of small gel cells that keep it going for a long time.

After building about every kit on the market, it amazes me that this design was originally a club venture. It was so successful that they had to do multiple runs of the kit, selling them all over the world.

Accessory Keyer/Counter

The Wilderness Radio NorCal 40A is revision B. The AGC performance has been improved. A low-pass filter has been added after the VFO to improve receiver image rejection by 10 dB, and improving the AGC and transmit/receive switching for better attack/delay times and reduced audio thumps. The case has nifty plastic latches and the chassis is supplied in a beautiful blue painted and silk-screened combination. Even though the cabinet is small, there is still room for the more advanced ham to play with added accessories such as small keyers.

One of Burdick's latest kits is also being offered by Wilderness Radio. This is the KC1 keyer/frequency counter. It is a small iambic keyer with 54 bytes of message memory and a displayless frequency counter that reports the frequency in Morse code. There is room

Continued on page 75

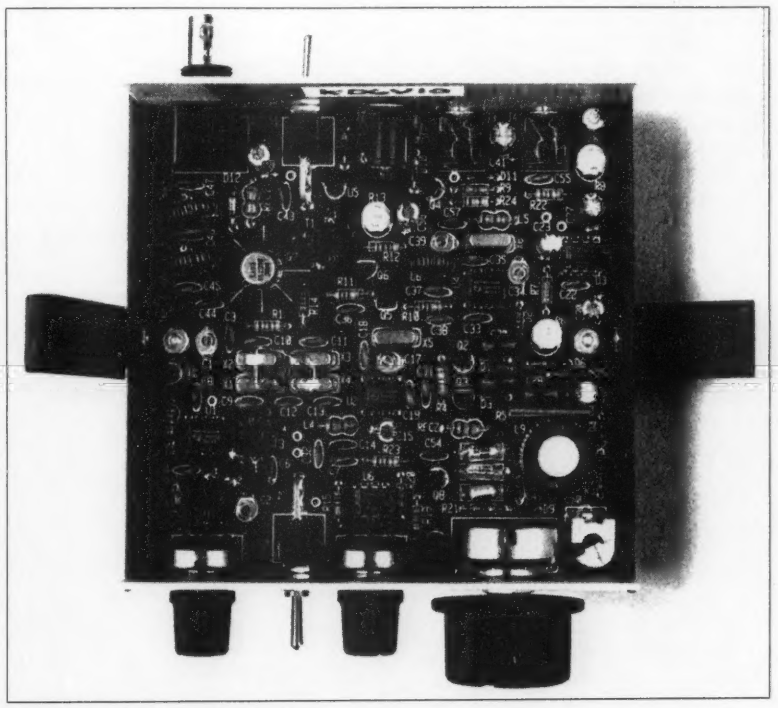


***Photo C.** Inside the completed unit.*

RTTY LOOP

Amateur Radio Teletype

Marc I. Leavey, M.D., WA3AJR
6 Jenny Lane
Baltimore MD 21208

It's here! After many months of anticipation, and quite a bit of work behind the scenes, the RTTY Loop Home Page is now available on the World Wide Web. While this column, running in the pages of *73* for more than eighteen years, has reached countless numbers of radio amateurs, the potential audience for the Loop on the Web is virtually unlimited.

To access the RTTY Loop Home Page, point your net browser to: http://www2.ari.net/ajr/rtty/ and the home page will be displayed. Fig.1 shows what you will see:

From the home page, you may jump to a full text of the current column, a listing of the software available in the RTTY Loop Software Collection, a download section for current or special software, and a page of links to other interesting sites. The column text is wired with hyperlinks to mentioned sites, so that clicking on a site's name described in the column will take you to that site. I will also try to make recent software mentioned in the column available for download, through the download section, as well as provide for any more specialized requests, if possible.

I hope that the RTTY Loop Home Page can be the first home page of an electronic edition of *73*. Let's see what the editors can do with that one!

Along with the new page come new addresses for correspondence. In order to get to your mail in a more timely fashion, I have a new address for the readers of RTTY Loop. Check out the top of the column, and address any snailmail to the P.O. Box. My new Internet address, in conjunction with the home page, is ajr@ari.net — although I continue to maintain accounts on CompuServe and America Online.

I received a note from "RC" KE6BGN, who wrote regarding the sound card article for packet and RTTY. He writes:

"I had a bit of a problem tracking down any of the sound cards that were listed in your article. I was told that of the sound cards you had listed, these were older sound cards and hard to come by. After some hard looking and calling, I found the telephone number of the makers of the Cardinal 16 sound card. They are located in Lancaster, Pa. and their number is: (717) 293-3049. I was told that they are no longer producing this card, but still have some in stock and are letting them go for a mere $60. When I asked them about the software development kit that was mentioned in your article, however, I drew a blank. I will try to find out more on this. This information might be nice to pass on to your readers.

"Also I have a question for you. In the article it said that if you were going to get a sound card to accomplish Packet and RTTY, it had to be based on the PSA standard. During my search, I asked several computer stores what this meant and was only partially answered at one store; that it stood for 'Packet something-or-other.' Needless to say when I heard the word 'packet' from a non-ham, this piqued my curiosity even further. Could you tell me what PSA stands for in relation to sound cards?"

Well, RC, I looked, too, and came up blank. I will assure you that "packet" is anything but an exclusive ham radio term. Most data networks in use today send data in packets, and the protocols in use, one of which is the X.25, often translate into amateur protocols, witness the AX.25 protocol. Good luck on the boards, though, and I will pass along whatever information I discover.

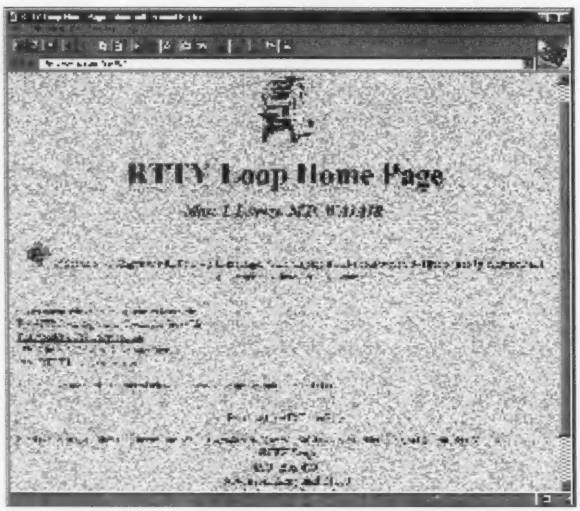
Jack, AAØJB, writes a note via America Online, in which he relates:

"I was reading your article in May 1995 about the program XPKM157 as written by KF7XP for the KAM and I got a copy via AOL and tried it out. Looks good but got a problem. I use COM 3 and IRQ 2 for my TNC. Tried to get the program to initialize but every time I hit the IRQ box my computer locked but good. Had to use the RESET control to get it going again. Would really like to try this program but looks like something is missing.

"Would like to know it KF7XP has a E-mail address. Maybe he knows of the problem and can offer a fix. Also, maybe you know of another place to get the latest download? The one in AOL was several months old. I tried the Internet address in your article but did not find a copy."

Well, Jack, as long as you are using "standard" settings for your COM port, you shouldn't have any problems. The latest copies of the programs can be had on the Internet Direct server, reachable through their web site, http://www.indirect.com, or download the files directly on the ftp site:

ftp://ftp.indirect.com/pub/software/hamradio/xpware. Take a look there, and see if that doesn't help answer your questions.



The Baycom project brought quite a few letters regarding availability of the integrated circuit central to the project. Rev. Greg Schluter, KC5FLI, writes that he obtained the TCM3105 integrated circuit from JDR Microdevices for $8.95. Their toll-free number is (800) 538-5000.

John Kirk, VE6XT, also notes that the chip should be available by mail order from Active Component Sales, as their Canadian parent stocks them. The US 800 number doesn't work in Canada, so he can't verify, but a call to (800) 934-5206 may turn one up. They also claim to stock the rather oddball crystal needed for a very reasonable price.

One last letter this month from Robert Twiggs, WA3YRI, who writes looking for any program for an IBM compatible that will perform RTTY/AMTOR using an AEA-CP1. He currently uses a C64 with AIRDISK and would like to get the thing working with his 486-DX66 PC. He does not have the RS232 option and knows that he will have to use a MAX232 or equivalent circuit to connect to the PC.

Well, Bob, this gives me an excellent opportunity to refer you to the RTTY Loop Software Collection. Several of the packages there may be of help to you, as well as some commercial programs we have mentioned in the column before, such as BMK-MULTY. The easiest way to get a copy of the software list is from the RTTY Loop Home Page but, if you have no web access, drop me a self-addressed, stamped envelope, to the above P.O. Box, please, or send me E-mail at ajr@ari.net on the Internet, or on CompuServe at 75036,2501; or America Online at MarcWA3AJR, and I will be happy to return the list to you. In the meantime, keep on looping, and don't miss the next issue of *73's* "RTTY Loop!" 73

HAMS WITH CLASS

Carole Perry WB2MGP
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Welcome Aboard!

"Welcome Aboard!" is the official Navy greeting. With it, I was invited to be a guest speaker at the U.S. Naval Academy in Annapolis, Maryland. After my wonderful experience last August, addressing the cadets at the West Point amateur radio club, how could I not visit Navy? I accepted the invitation of Lt. Commander Herb Elkins A3FDO and Midshipman 1/C Trevor Bast KA8ZUO, and I was on my way .

The ride over the Chesapeake Bay Bridge is a real experience. The view of the sun going down over the myriad of boats in the water was simply breathtaking. My tour of the "Yard," which is the traditional name of the Naval Academy's campus, was enlightening and impressive. The architecture is a combination of French Renaissance and contemporary style. The campus has expanded to 338 acres. Monuments throughout the Yard commemorate the bravery and heroism that are an important part of the academy's heritage. Buildings and walkways are named for graduates who have contributed to the naval history and to the nation; graduates such as Admirals Chester Nimitz, William "Bull" Halsey and Hyman Rickover, President Jimmy Carter, and 40 astronauts. The brigade-size student body of 4,000 midshipmen participate in a 140-semester-hour program which incorporates a core curriculum of required courses, plus a choice of 18 major fields of study, a wide variety of elective courses, and advanced study and research opportunities for highly motivated students. Classes are taught by 600 highly qualified faculty members. About half are civilian scholars and half are experienced military officers.

My tour guide for most of the day was Trevor Bast, president of the amateur radio club. It was a pleasure to be in the company of such high caliber students as Trevor. One of the highlights of my day was watching the "formation" for lunch outside Bancroft Hall. It's not often that I get to see 4,000 young men and women line up with such precision. It's even less often that I get to eat lunch with such an outstanding group.

W3ADO

While visiting the ham station, I got to meet with Bob Bruninga WB4APR, who is a retired Navy commander and is the trustee and technical coordinator for the station, W3ADO. While the station I visited was in small quarters back in August, the club plans to move to a larger facility. It may have been tight quarters, but the view of the bay was spectacular.

The amateur radio club is the Naval Academy's oldest extracurricular activity, dating back to 1928. For many years it has provided midshipmen with the opportunity to become licensed, to upgrade their present licenses, to enjoy a relaxing hobby, or to pursue specific technical interests within the hobby. The club station is available to all members at any time. In recent years midshipmen have attempted to communicate via moonbounce, satellite, and packet.

***Photo A.** Watching a formation of the brigade was an exciting experience.*

***Photo B.** (Left to right) Trevor Bast KA3FDO, president of ARC W3ADO, and Lt. Commander Herb Elkins KA3FDO in the "Model Room," in front of a take-apart generator.*

The club is well equipped for HF communications. They currently use a Kenwood TS-440S and an ICOM IC-701 through a Cushcraft R-5 vertical and a G5RV antenna. Three mobile VHF FM transceivers, two Kenwood TM-251As, and a Kenwood HT give excellent 2 meter capabilities. Two PCs, an MFJ 407B, and an AEA Packratt allow them to operate VHF and HF packet from the station. The many technical resources of the academic departments are often available for the club's use. In the past that avenue has provided them with the use of a satellite dish and all-mode VHF capabilities.

The ever-popular and traditional Army-Navy football game provides the club with a reason to set up a special events station every year. Last year on Saturday, December 2nd, they operated from the stadium in Philadelphia for the duration of the game. The normal routine is to operate SSB in the general portion of 20 and 40 meters.

Last spring, the club had the privilege of operating during a shuttle mission as part of the SAREX program. Club members as well as interested faculty were able to communicate with the astronauts for approximately half an hour. The exchange between the *Atlantis* and the midshipmen included each sending the other a short video presentation. "Yeah, I've got color!" Lt. Col. Cameron said upon receiving the academy's video. "Man, great pictures." The exchange represented the first time that a space shuttle has successfully received video from the ground. Usually it's the astronauts who are sending the pictures.

Later that evening I addressed a group of midshipmen who were considering joining the club and wanted to learn more about ham radio. I can't describe how exciting it was for me to look out at a "sea" of white uniforms in the auditorium. With all the demands put on the midshipmen's time, it was nice to see such a good turnout of students interested in pursuing radio. We spoke about the possibility of my lending assistance to those club members who were considering setting up classes in local schools as part of their community service. Perhaps we can do a follow-up column in "Hams With Class" to let folks know how the project went. The ham radio operators at W3ADO seemed very receptive to the idea of scheduling contacts with younger school children. They are an enthusiastic, bright, and extremely hospitable group of young adults.

***Photo C.** The members of the W3ADO ARC were an enthusiastic and hospitable group.*

I thank my hosts for a most enjoyable weekend, and I look forward to some outstanding contacts. 73

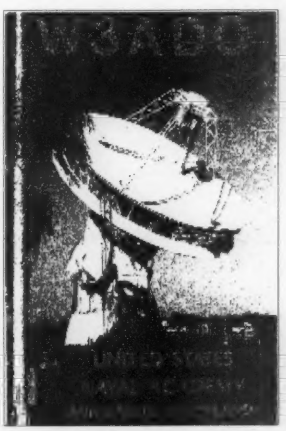

***Photo D.** QSL card for W3ADO.*

HAMSATS

Amateur Radio Via Satellites

Andy MacAllister WA5ZIB
14714 Knights Way Drive
Houston TX 77083

Satellites on a String

Ham radio balloon projects are not new, but they are fun, educational, and exciting. They are a lot easier and cheaper to design, build, and launch than satellites. Amateur balloon launches have been used to test ideas for future satellites, like the pre-AMSAT OSCAR 7 tests in West Germany in the early 1970s.

Most of today's amateur radio balloon launches focus on digital and voice communication experiments and amateur television systems. The payloads usually weigh from 4 to 12 pounds and can be sent to altitudes over 90,000 feet with a $40 balloon and another $50 for helium.

"Today's typical balloon can cost $80,000 and have a payload weight of more than 3,000 pounds."

Payloads are designed for light weight and low current consumption. They must also be built to survive near-vacuum and extreme cold. Power is usually provided by sulphur-dioxide lithium batteries, and antennas are typically omnidirectional ground planes or vertical dipoles. Lots of foil is used for shielding, and styrofoam for padding and rigidity. Voltages, currents, and temperature probes are monitored by small dedicated computers that send data to the ground as telemetry.

After a typical ham radio balloon is launched, the communications experiments, either crossband repeaters or packet digipeaters, find many takers. With an altitude of 100,000 feet, the horizon (as seen from the balloon) is 400 miles distant. For a north Texas launch, it is possible for hams in Salina, Kansas, to talk with others in Corpus Christi, Texas, through an appropriately programmed dual-band HT at the balloon. Video cameras with small 1- to 10-watt ATV transmitters have provided spectacular views from 20 miles up.

When the balloon finally achieves maximum altitude, it pops. A direction-finding team is customarily in place to chase the package as it parachutes back to earth. Years ago this was a grueling "foxhunt," since no one knew where the package would land. Computer predictions help, but the final few miles to the crash site are never easy. Today, many groups use

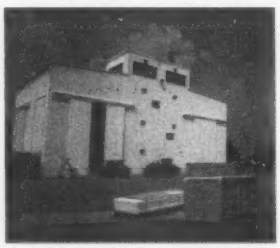

Photo B. *One of several buildings at the Palestine, Texas, NSBF facility (Ken Axelson photo).*

Global Positioning System (GPS) receivers on the package, hooked through packet Terminal Node Controllers (TNCs), and VHF or UHF transmitters to broadcast the location of the payload during the flight. It's much easier to simply note coordinates on a map or laptop computer system, and then walk right up to the payload after landing.

Three ham radio balloon groups in Texas decided to find out how the "big boys" launch scientific balloons. Members of the

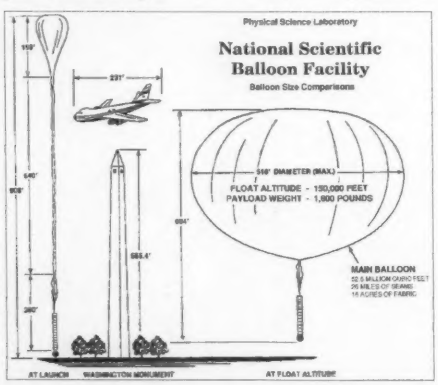

Photo A. *Balloon size comparisons (NSBF/NASA drawing).*

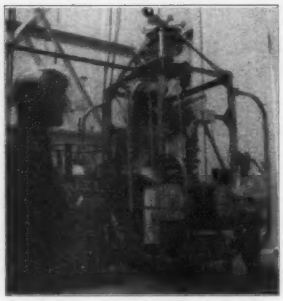

Photo C. *Several "serious" payloads are launched from the Palestine location every year. This one was sponsored by educational institutions in California and Italy (Ken Axelson photo).*

South Texas Balloon Launch Team, the North Texas Balloon Project, and the Clear Lake Amateur Radio Club balloon group converged on Palestine, Texas, home of the National Scientific Balloon Facility. These three groups have collectively launched nearly 20 balloon payloads to the edge of space in the last five years.

Go to Buffalo and Head East

Palestine, Texas, is about 180 miles north of Houston and 100 miles south of Dallas, just 36 miles east of Buffalo. This town of 18,000 has been home for the National Scientific Balloon Facility since 1963, when the name was just the Scientific Balloon Facility. Originally aligned with the National Center for Atmospheric Research and the National Science Foundation, the installation is now sponsored by the National Aeronautics and Space Administration (NASA), and operated by the Physical Science Laboratory under the auspices of New Mexico State University of Las Cruces, New Mexico.

The primary goal of the NSBF is to plan and develop facilities and to provide operations to meet the ballooning requirements of the scientific community. The organization also performs research and development to meet future ballooning requirements and provides consulting services in the field of scientific ballooning. It takes a team of 78 engineers and technicians to contribute consulting, helium storage, preflight rigging, launching, tracking, electronic and meteorological support, and payload recovery.

The facility has launched more than 1,700 balloons for 35 universities, 23 other research agencies, and 33 foreign groups. Today the average payload weight is more than 3,000 pounds, with a balloon volume in excess of 28 million cubic feet. Payloads up to 5,000 pounds with 40 million cubic feet of balloon volume are quite common. Top altitudes are usually up to 125,000 feet. A typical balloon may cost $80,000, with $40,000 of helium. It may sound expensive, but it's much cheaper than a typical ...satellite launch.

Payloads cover many types of research, including cosmic-ray studies; gamma-ray, X-ray, optical, infrared, and ultraviolet astronomy; atmospheric sciences; magnetospherics; and micrometeorite particle studies.

Communications gear on the balloon payloads varies from simple to highly sophisticated. For local flights, typical VHF or L-band systems are used for telemetry and control. Long-duration flights, where the payload will travel beyond the horizon, require more complexity. Satellite links through ARGOS, INMARSAT, and NASA's TDRSS are used. The NSBF is involved in multi-day launches from Antarctica which necessitate the satellite links.

The Tour

Dwight Bawcom, manager of the National Scientific Balloon Facility, and Bob Moody K7IRK provided the ham radio balloon groups with a three-hour tour. Dwight began the program with a short talk on the work done at the facility and some videotape footage of various launches from Texas, New Mexico, and Antarctica. It was a great way to get started, since most of those attending were not aware of the tremendous scope of large scientific balloon launches.

Payloads and balloon volumes have increased by a factor

Continued on page 74

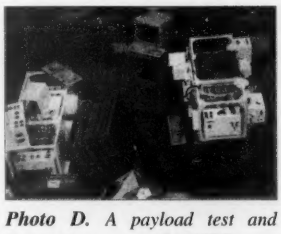

Photo D. *A payload test and integration area at the NSBF.*

QRP

Number 55 on your Feedback card

Low Power Operation

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As I was walking through the hamfest, I spied a Ten-Tec Century 21 lurking deep inside a rusted-out Escort. Upon first impression, it didn't look too bad. There were the usual scratches on the top, and an odd-looking switch where the "spot" function should be.

Looking the rig over, I half-heartedly said, "What are you asking for the 21?" "Two hundred," was the reply. I returned with the usual hamfest barter: "Well, that's a bit more than I wanted to go."

"Well then, what are you willing to go?"

Thinking I would offer a really silly low price and then meet in the middle, I tossed out, "A hundred bucks." He paused for a few seconds, and I knew he was going to counter my offer with something a little higher. He looked up and said, "Sold!"

Ever since I was dropped on my head as a child, I've been hearing voices. But at this moment, one really loud voice could be heard saying, "Captain, the deflectors just came online!" Of course, being my own captain, I set my own course. Ignoring the warning, I asked, "What's wrong with the rig?"

"Nothing. Works great! Just had it on the air last weekend." This time another voice cried, "Engines are standing by! Let's get out of here!" I ignored this warning as well and plunked my money down.

We returned home, and after we'd unpacked and rested a bit, I proceeded to check out my new toy.

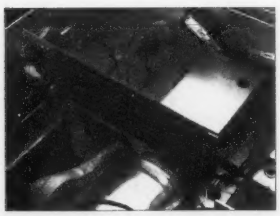

***Photo A.** The power supply shunt inside the Century 21.*

The Century 21

For those who can't remember the Century 21, let me take a few minutes to explain this radio. The Century 21 is a five-band CW-only transceiver. It has an RF power output of about 35-40 watts. Of course, this is quite a bit above the 5 watts normally associated with QRP operation. The Century 21 is powered by an internal power supply, with no means of external 12 VDC operation. You can get around this handicap if necessary, though.

It's surprising that the Century 21 is a multiband *direct conversion* based transceiver and not a superhet design. It is also unusual that the Century 21, with its direct conversion receiver, operates with a built-in AC supply. Direct conversion receivers are noted for their pickup of any nearby AC fields and for the hum they generate.

First Problems

Upon powering up the rig, it became instantly clear things were not exactly up to factory specs. First, the 20 meter band was completely dead. Nothing at all could be heard on this band. The other bands seemed to be working—until I tried to transmit. On 80 meters I had all of 15 watts of output, somewhat less on 40. Twenty meters was dead on transmit, too. Ten meters showed little life, but did move the wattmeter's needle up a bit.

Now, to add salt to the wound, those two voices I had heard at the time I was thinking of getting this rig were jumping up and down yelling, "We told you so! We told you so!"

During testing of the transmitter, the overcurrent protection circuit in the power supply kept shutting down the supply. The meter monitoring RF output never reached the point to cause the supply to shut down. After a few minutes of operation, the supply would hardly run the receiver at full volume. So, problem number one was going to be centered on the power supply and its controls.

To prevent the supply from kicking out, I disabled the main +12 volts to the PA stage (something I would get really good at doing).

The power supply inside the Century 21 is built around a design used by several of the Ten-Tec power supplies. In fact, it's basically the same design used in the power supply I had for my old Triton 4.

The design is a basic full wave bridge rectifier and filter capacitor, with a 723 voltage regulator chip doing all the work. A single pass transistor is mounted on the rear apron of the Century 21. What makes the circuit stand out is the overcurrent shutdown protection.

There is a shunt inserted into the negative lead of the power supply. Since the shunt is really a very low value resistor, a small voltage is generated across it. This voltage is applied to a divider circuit and then sent along to an SCR.

As long as the current flowing through the shunt is within the setting provided by RF, the supply operates normally. However, if a problem occurs, such as excess current to the PA stage, then the SCR will fire, removing drive from the pass transistors and shutting down the power supply. To reset the SCR and the power supply, you must turn off the rig, then power back up. If you did not fix the problem, the supply will again shut down. The process will repeat until the current falls to within the setting of the trip trimmer.

One of the best things about the Century 21 is the wide open spaces between the top and bottom covers. You can really walk right in and have plenty of room to work. Upon closer examination of this unit I could see that I was not the first person to touch soldering iron to power supply! There was clearly some damage on the PC board, and several wires had the insulation melted off. There were too many tacked solder joints to count.

A few checks showed that the bulk of the power supply was in working order. This included the transformer and rectifier/filter. The output pass transistor, as well as the driver transistor, had been replaced by someone else. Ten-Tec does not use NTE solid-state devices and three pounds of thermal grease on its pass transistors. The problem was traced to several failed tacked solder joints and a lifted PC board trace. As the circuit heated, the solder joints opened and upset the voltage divider, setting off the SCR which, in turn, shut down the supply.

***Photo B.** Notice the burnt insulation near the terminal strip. The two trimmers on the top of the PC board set the voltage and current trip points for the supply.*

Repair consisted of re-soldering all joints and replacing the interconnecting wires between the power supply PC board and the rest of the circuits. The heavy gauge wire to and from the pass transistor was also replaced.

Frying Eggs, Sizzle and Smoke

After putting the power supply back together, I made a quick check; the repairs seemed to be correct. The supply now held on even during receive.

So, with a dummy load and wattmeter attached to the antenna jack, I keyed the unit and attempted to set the RF output with the drive control.

On 80 meters, I had 30+ watts of RF output and 20 watts on 40. I advanced the drive control until it was in its stops and there was still no increase in output power. Then the power supply shut down. Resetting the supply and reducing the drive control again, I attempted to increase drive once more. This time, with the drive control only halfway up, the PA sounded like someone was frying eggs inside. A few seconds later, plumes of smoke started to emerge from the cracks.

After the smoke cleared and the PA cooled down, a look inside revealed that the final transistors, or what remained of them, were history. Now, I wonder if the trouble with the power supply this time (and in the past) was related to the bugs hiding inside the PA?

We'll pick up the pieces and continue next month. 73

CARR'S CORNER

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Transmission Lines (A Bunch of 'Em)

Fig. 1 shows several basic types of transmission line. Perhaps the oldest and simplest form is the *parallel line* shown in Fig. 1A. This type of transmission line consists of two identical conductors parallel to each other and separated by a dielectric (i.e. insulator). A familiar example of a parallel transmission line is the "twin-lead" used on many television broadcast receiver antennas. For years the microwave application of parallel lines was limited to educational laboratories, where this type of line is well suited to performing experiments (to about 2 GHz) with simple, low-cost instruments. Today, however, printed circuits and hybrid semiconductor packaging have given parallel lines a new lease on life, if not an overwhelming market presence.

The second form of transmission line, which finds considerable application at microwave frequencies, is *coaxial cable* (Figs. 1B through 1E). This form of line consists of two cylindrical conductors sharing the same axis (hence "co-axial") and separated by a dielectric. For low frequencies (in flexible cables), the dielectric may be polyethylene or polyethylene foam, but at higher frequencies Teflon™ and other materials are used. Also used in some applications are dry air and dry nitrogen.

Several forms of coaxial line are available. Flexible coaxial cable is perhaps the most common form. The outer conductor in this type of cable is made of either braid or foil. Again, television broadcast receiver antennas provide an example of such cable. Another form of flexible or semi-flexible coaxial line is *helical line*, in which the outer conductor is spiral wound. *Hardline* is coaxial cable that uses a thin-wall pipe as the outer conductor. Some hardline coax used at microwave frequencies uses a rigid outer conductor, and a solid dielectric.

Gas-filled line is a special case of hardline which is hollow (Fig. 1C), with the center conductor supported by a series of thin ceramic or Teflon™ insulators. The dielectric is either anhydrous (i.e. dry) nitrogen or some other inert gas.

Some flexible microwave coaxial cable uses a solid "air-articulated" dielectric (Fig. 1D), in which the inner insulator is rigid, rather than continuous around the center conductor. Reduced dielectric loss increases the usefulness of the cable at higher frequencies. Double-shielded coaxial cable (Fig. 1E) provides an extra measure of protection against radiation from the line, and EMI from outside sources, from getting into the system.

A variant that seems to combine the advantages of both parallel and coaxial concepts is shown in Fig. 1F. This form of transmission line is called *shielded parallel line*. As in the parallel line, the two conductors are spaced a certain distance (S) apart and are parallel to each other. In the shielded variety, however, an outer conductor (a shield) is also provided.

Stripline, also called *microstripline* (Fig. 1G), is a form of transmission line used at high UHF and microwave frequencies. The stripline consists of a critically-sized conductor over a ground plane conductor, and separated from it by a dielectric. Some striplines are sandwiched between two ground planes, and are separated from each by a dielectric.

The characteristic impedance for a specific type of line is a function of the conductor size, the conductor spacing, the conductor geometry (see Fig. 1 again) and the dielectric constant of the insulating material used between the conductors. The dielectric constant (n) is equal to the reciprocal of the velocity (squared) of the wave when a specific medium is used:

$$\epsilon = \frac{1}{V^2}$$

Where:

n is the dielectric constant

v is the velocity of the wave in the medium

(Note: for a perfect vacuum, n = 1.000).

a) Parallel Line:

$$Z_o = \frac{276}{\sqrt{\epsilon}} \text{ LOG } \frac{2s}{d}$$

Where:

Zo is the characteristic impedance, in ohms

n is the dielectric constant

S is the center-to-center spacing of the conductors

d is the diameter of the conductors

b) Coaxial Line:

$$Z_o = \frac{138}{\sqrt{\epsilon}} \text{ LOG } \frac{D}{d}$$

Where:

D is the diameter of the outer conductor

d is the diameter of the inner conductor

c) Shielded Parallel Line:

$$Z_o = \frac{276}{\sqrt{\epsilon}} \text{ LOG } \left(2A \times \frac{1-B^2}{1+B^2}\right)$$

Where:

A = s/d

B = s/D

d) Stripline:

$$Z_o = \frac{377}{\sqrt{\epsilon}} \quad \frac{T}{W}$$

Where:

nt is the relative dielectric constant of the printed wiring board (PWB)

T is the thickness of the printed wiring board

W is the width of the stripline conductor

The relative dielectric constant (nt) used above differs from the normal dielectric constant of the material used in the PWB. The relative and normal dielectric constants move closer together for larger values of the ratio W/T.

In practical situations we usually don't need to calculate the characteristic impedance of a stripline, but rather design the line to fit a specific system impedance (e.g. 50 ohms). We can make some selection choices of printed circuit material (hence dielectric constant) and thickness, but even these are usually limited in practice by the availability of standardized boards. Thus, stripline *width* is the variable parameter.

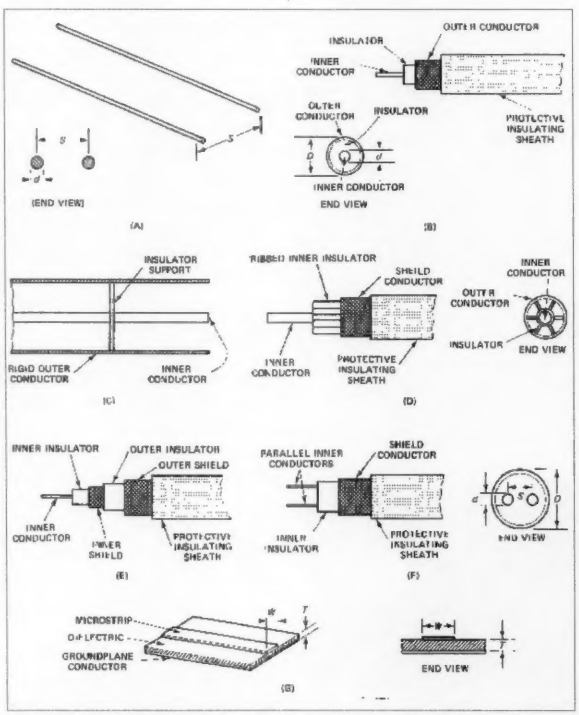

Fig. 1. Types of transmission line.

Equation 5 can be rearranged to the form:

$$W = \frac{377T}{Z_o\sqrt{\epsilon}}$$

The 50-ohm impedance is accepted as standard for RF systems, except in the cable TV industry. The reason is that power handling ability and low-loss operation don't occur at the same characteristic impedance. For coaxial cables, for example, the maximum power handling ability occurs at 30 ohms, while the lowest loss occurs at 77 ohms; 50 ohms is therefore a reasonable trade-off between the two points. In the cable TV industry, however, the RF power levels are minuscule, but lines are long. The trade-off for TV is to use 75 ohms as the standard system impedance in order to take advantage of the reduced attenuation factor.

Velocity Factor

In the discussion preceding this section we discovered that the velocity of the wave or signal in the transmission line is less than the free-space velocity, i.e. less than the speed of light. The velocity is related to the dielectric constant of the insulating material that separates the conductors in the transmission line. Velocity factor (v) is usually specified as a decimal fraction of c, the speed of light (3×10^8 m/s). For example, if the velocity factor of a transmission line is rated at "0.66," then the velocity of the wave is 0.66c, or $(0.66)(3 \times 10^8 \text{ m/s}) = 1.98 \times 10^8$ m/s.

Velocity factor becomes important when designing things like transmission line transformers, or any other device in which the length of the line is important. In most cases, the transmission line length is specified in terms of *electrical length,* which can be either an angular measurement (e.g. 180 degrees or 9 radians), or a relative measure keyed to wavelength (e.g. one-half wavelength, which is the same as 180-degrees). The *physical length* of the line is longer than the equivalent electrical length. For example, let's consider a 1-GHz half-wavelength transmission line.

A rule of thumb tells us that the length of a wave (in meters) in free space is 0.30/F, where frequency (F) is expressed in gigahertz; therefore, a half-wavelength line is 0.15/F. At 1 GHz, the line must be 0.15 meters/1 GHz, or 0.15 meters. If the velocity factor is 0.80, then the *physical length* of the transmission line that will achieve the desired *electrical length* is [(0.15 meters)(v)]/F = [(0.15 meters)(0.80)]/1 GHz = 0.12 meters. The derivation of the "rule of thumb" is left as an exercise for the student. (Hint: It comes from the relationship between wavelength, frequency and velocity of propagation for any form of wave.)

There are certain practical considerations regarding the velocity factor that result from the fact that the physical and electrical lengths are not equal. For example, in a certain type of phased array antenna design radiating elements are spaced a half-wavelength apart, and must be fed 180-degrees (half-wave) out of phase with each other. The simplest interconnect is to use a half-wave transmission line between the 0-degree element and the 180-degree element. According to the standard wisdom, the transmission line will create the 180-degree phase delay required for the correct operation of the antenna. Unfortunately, because of the velocity factor the physical length for a one-half electrical wavelength cable is shorter than the free-space half-wave distance between elements. In other words, the cable will be too short to reach between radiating elements by the amount of the velocity factor!

Clearly, velocity factor is a topic that must be understood before transmission lines can be used in practical situations. Table 1 shows the velocity factors for several types of popular transmission line.

Transmission Line Noise

Transmission lines are capable of generating noise and spurious voltages that are seen by the system as valid signals. Several such sources exist. One source is coupling between noise currents flowing in the outer conductor and the inner conductor. Such currents are induced by nearby electromagnetic interference and other sources (e.g. connection to a noisy ground plane). Although coaxial design reduces noise pickup, compared to parallel line, the potential for EMI exists. Selecting high-grade line, with a high degree of shielding, reduces the problem.

Another source of noise is thermal noises in the resistances and conductances. This type of noise is proportional to resistance and temperature.

There is also noise created by mechanical movement of the cable. One species results from movement of the dielectric against the two conductors. This form of noise is caused by electrostatic discharges in much the same manner as the spark created by rubbing a piece of plastic against woolen cloth.

A second species of mechanically-generated noise is piezoelectricity in the dielectric. Although more common in cheap cables, you should be aware of it. Mechanical deformation of the dielectric causes electrical potentials to be generated.

Both species of mechanically-generated noise can be reduced or eliminated by proper mounting of the cable. Although rarely a problem at lower frequencies, such noise can be significant at microwave frequencies when signals are low. 73

Type of Line	Z_o (ohms)	Vel. Factor (v)
1/2-in. TV Parallel	300	0.95 Line (Air Dielectric)
1-in. TV Parallel	450	0.95 Line (Air Dielectric)
TV Twin-Lead	300	0.82
UHF TV Twin-Lead	300	0.80
Polyethylene Coaxial	*	0.66 Cable
Polyethylene Foam	*	0.79 Coaxial Cable
Air-Space Polyethylene	*	0.86 Foam Coaxial Cable
Teflon™	*	0.70

* Various impedances depending upon cable type.

Table 1. *Transmission Line Characteristics*

Every Ham's Average

Continued from page 44

value on FM, FSK or other modes where output power is essentially constant.

This article refers to "Average/Peak" reading, because this terminology is normally the accepted wording, although it is not strictly true. The average power of a sine wave is about 63% of peak power, while root-mean-square (rms) of a sine wave is 70.7% of peak value. The rms value of a sine wave delivering power to a non-reflective load is the exact equivalent of a DC voltage of the same value as the rms value when delivering power to a resistive load. This instrument actually indicates rms power levels, which are somewhat higher than average power would be, and therefore are more accurate in indicating the *really effective power* being transmitted. Although I wanted to call the article "RMS/Peak" power, I felt the apparently unusual use of the term "rms" might be confusing, so I bowed to convention and am describing here what is actually happening in this instrument.

Although this RF wattmeter is intended to be left in the coax line between the transmitter and its load, whether dummy, antenna or antenna tuner, you may notice that the output power indicated when using a tuner may differ somewhat from that observed into a 50-ohm dummy load, even though the SWR indicates a 1:1 ratio. There are a couple of reasons for this. First, not all dummy loads are exactly 50 ohms—mine is 51.6 ohms. Second, the output impedance of a transmitter varies with the output level and the operating voltage supplied to the power transistors in the final amplifier stage. The actual output

Continued on page 62

HAM TO HAM

Your Input Welcome Here

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Your Input

I'll begin this month by saying a hearty "thanks" to all who have been sending in their suggestions, modifications, tips, techniques, and favorite easy-to-build circuits. The amount and the quality of input has been very gratifying and if it keeps up as it has been, the column will indeed go on for a very long time to come. This tells Uncle Wayne that it's a needed addition to *73* and encourages me to put even more of your ideas to work via these pages. So keep those ideas coming in; we can never have too many.

Let me just take a moment to outline once again what I'm looking for in the way of ideas. Basically, anything that will help your fellow hams; tips, suggestions or shortcuts are fair game. Things that you've discovered that perhaps you wish you had known about earlier in your own ham radio career are always helpful. The idea can be technical in nature, an operational shortcut or convenience, a new use for a tool that has ham radio applications, or an innovative way of doing something that might otherwise be a real chore. Equipment modifications are sometimes worthwhile, but please make sure that you've thoroughly tested the mod, that it's not going to cause any unwanted side effects, and that it's easily reproducible by others with the same piece of gear—not just a fluke. It's impossible for me to test each idea, especially if it involves an item of equipment that I don't own, so be completely sure that there are no "gotchas" hidden away.

Also, I'm not looking for extremely complex circuits or new and involved concepts; they're best left for full-length articles, or perhaps a doctoral thesis. I'd prefer ideas that can be understood and implemented fairly quickly by all of our readers, ideas encompassing just two or three paragraphs of column space. That allows for more ideas to be published per month, since there are obviously limitations on space within each issue. I'd like to see "Ham To Ham" eventually be the first column read by *73* subscribers...after Uncle Wayne's editorial, of course! The greatest compliment to the contributors will be when a number of readers begin to make a file of the tips and suggestions published here, saving them for future reference. That's pretty much our current goal; let me know whether or not that corresponds with the direction that you'd like to see the column take.

Please don't send me ideas that have been submitted elsewhere and are still pending acceptance by other publications, or ones that have been previously published. Only new, original, unpublished ideas are usable.

I'll try my best to respond as quickly as possible to each legitimate idea sent to me, since I'm sure that you'll want to know if it's what we're looking for. So far, the vast majority of submissions have been right on the mark of what we're intending for the column. This is your column, echoing your ideas and technical suggestions, to make our hobby more fun for each of us.

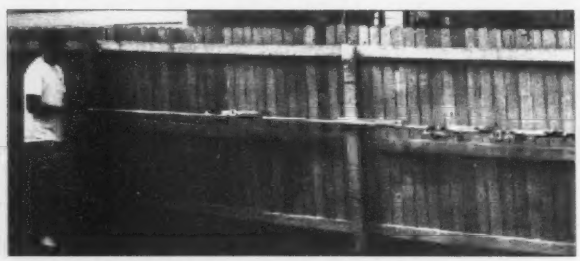

Photo A. Paul KBØSJX with his HF vertical in the "resting" position, hung from the wooden fence alongside his house...and out of his neighbors' sight.

Putting "Sparkle" Back Into Your Ham Gear

Probably nothing looks less impressive to "visiting dignitaries" than dusty, dingy-looking equipment in your ham shack. You can put that new-look sparkle back into almost any piece of gear by simply applying a small amount of Armor All Protectant® to the equipment's exterior surfaces with a small cotton ball. It comes in both glossy-finish and dull-finish; it's quick and the results are impressive.

"Power-Up" Message Idea

From Bruce Tennant KE6PZW, Box 7325, Long Beach CA 90807-0325**:** Since some of the newer handie-talkies offer a programmable, customized message upon power-up, here's a tip that might save some grief for your repeater group, as well as enable a stolen HT to be returned to its rightful owner.

The manufacturers of these HTs suggest in their manuals that the owner's name and callsign be programmed into this "power-up message," but by doing that, you may be playing right into the hands of an illegal user. How? Well, should your HT fall into the wrong hands, especially those of a non-ham, then not only would they have your HT, but immediately upon powering it up, they would have your callsign too! The temptation for such unscrupulous thieves to use not just your HT but your call as well may be just too great.

My tip would be: Don't program in your name or call; use your driver's license number or other form of state identification that could possibly place your HT back into your hands should the police or other agency find it as part of the loot of a captured thief. Law enforcement officials have suggested engraving a driver's license number, along with the state's initials (such as CA for California), into valuables for years now. State and local police have access to the legitimate holders of these numbers and have been able to return stolen goods to many people by this method. Another plus is that an unauthorized user probably wouldn't have the sophistication (or the manual to tell him how) to delete your power-up message from the HT's memory, and it might make him more reluctant to use or sell it.

Note: Excellent suggestion, Bruce. Perhaps the manufacturers should market the feature in this manner, i.e. as an anti-theft "plus." It also makes us all think twice about putting our calls on our portable or mobile equipment in any form. A driver's license number would be a much better thing to use, whether it's in electronic form or otherwise.

A Sticky Subject

In case you haven't tried it, a good all-purpose adhesive is Weldbond®. It's made in Canada and is available in the U.S. in craft and hobby stores. There are many uses for this product in our ham-radio construction and repair "adventures," so you may already be familiar with this adhesive. A nice feature is that the bond remains slightly flexible when cured, which in my experience has better impact resistance than adhesives that become hard and brittle after curing or with age.

Now You See It...Now You Don't!

From Bryon "Paul" Veal KBØSJX, 5855 E. 124th Way, Brighton CO 80601**:** Living in an area with a homeowner's covenant banning permanent outdoor antenna structures, and wanting to operate 10 meters with my new Tech-plus license, while honing my CW skills on 40 meter CW in preparation for the General exam, I was faced with a not-so-unusual modern dilemma...how to accomplish all of that while keeping a low profile with the homeowners' association sleuths! Here's hoping that my answer may help other hams in similar situations.

I purchased a multiband 1/4-wave vertical that I felt had a good reputation for ease of installation and use. My plan? To mount the antenna temporarily on a permanently-installed pipe that extends out of the ground

Continued on page 62

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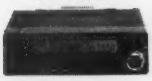

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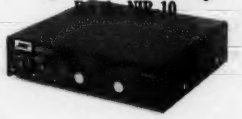

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* See reviews in "funk" 11/95 and "Radio-Hoeren" 6/95

Do You Remember?

Continued from page 22

QBE?

The 310B?

Any Hunter rig?

The Drake 1A?

Hammurlund, Hallicrafters, and National?

ICE?

Varitronics?

Sideband Engineers, Gonset, and Central Electronics?

Heathkit, Johnson, and Collins?

The Swan 500?

Twin Vs (not "Twin Peaks")?

The "Outercom"?

The 200V?

When all major companies had QSL cards for their employees?

The Warrior?

The 2B (or was it "not to be")?

The SW3?

The Ocean Hopper?

I could go on for hours. But, all the "old-timers" will get the point, and all the "newcomers" will scratch their heads. However, it is nice to take a nostalgic look and just remember. 73

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CIRCLE 160 ON READER SERVICE CARD

The Icom 706

Continued from page 40

processors, synthesizers, and memory, and this equates to current drain. The receiver draws 1.5 amps all the time. I measured the total current drain at various power levels at 160 meters and 6 meters. The results are shown in Table 1.

Power consumption is important to me because I use a Ten-Tec 938 switching power supply for portable operation. The cooling fan is always running. It is not noticeable on receive, but it comes on full power whenever you transmit and is noticeable. However, this is understandable, considering the size of the radio and the fact that you are trying to dissipate 176 watts(!) keydown (20A X 13.8V - 100 watts); a good cooling fan is needed. I got used to the fan quickly, and it is really not a problem when you are talking.

There are so many features to this radio that I can't possibly cover them all, but I do have to mention a couple of other neat ones. One of these is the "band scope." With this you can sweep the band and paint a picture of signals on the display very similar to a spectrum analyzer! This is really great for monitoring quiet bands for signals (like 17 meters). Another neat feature is that you can get a display of the IF filter passband which moves right and left as you tune the IF shift!

No rig is perfect, but the IC-706 sure comes close! Now, maybe the Icom engineers or a hacker can figure out how to permit crossband operation so we can operate through some satellites, such as the 15-to-10 meter RS-12, with it.

I like the IC-706. It has virtually all the features you need for base and mobile! Finally, it is user-friendly and works great. Icom definitely has a winner here! I more than got my money's worth with this beaut! 73

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CIRCLE 42 ON READER SERVICE CARD

A Hot, Selective 2m Receiver

Continued from page 38

All of this fits easily on the 4" x 3.5" circuit board, making it easy to build the R-100 into a small housing or existing cabinet.

You may be thinking that the R100 sounds like just the ticket—commercial quality, great specs, and a very reasonable price. But the thought of actually putting a whole receiver together from a kit is a little scary. Is not to worry. In the first place, the R-100 uses an IC for the entire IF/Detector/Squelch section, which keeps the overall parts count low. A second IC is used for the audio amplifier section, and five more transistors make up the total active device count. Second, the instruction manual is quite explicit, the parts are well-marked, and the double-sided plated-through PC board makes the soldering easy. And third, well, if the unthinkable should happen, there is an in-depth troubleshooting section that should lead you to the source of the problem. The R-100 can probably be assembled in a few casual evenings, or in one night if you're an experienced (or highly motivated) builder.

In any case, the R-100 is probably not an ideal first-timer kit, but it would certainly qualify as suitable for an intermediate builder. As usual, the Hamtronics manual doesn't stop simply with construction details. Tips are given on how to mount the receiver, how to connect antennas, how to use the R-100 in a repeater, how to add a discriminator meter and S-meter, and even how to hook up subaudible tone decoders. Once built, you'll need a high-impedance voltmeter and a signal generator for alignment—both pieces of equipment are usually available through some member of your ham club if you don't have them already. (One thing you'll need that you may not have, and Hamtronics doesn't give you, is a set of tuning tools for the square-holed slugs in the coils. You can order one at the same time you order the radio.)

Whether you use the R-100 as a monitor receiver for the local repeater, a dedicated RF link, or as the receiver in a 2m repeater, you'll find it to be rock-solid, even in heavy RF environments. The R-100 is available in kit form, or fully assembled. Crystals are optional, and are available from Hamtronics, Inc. 73

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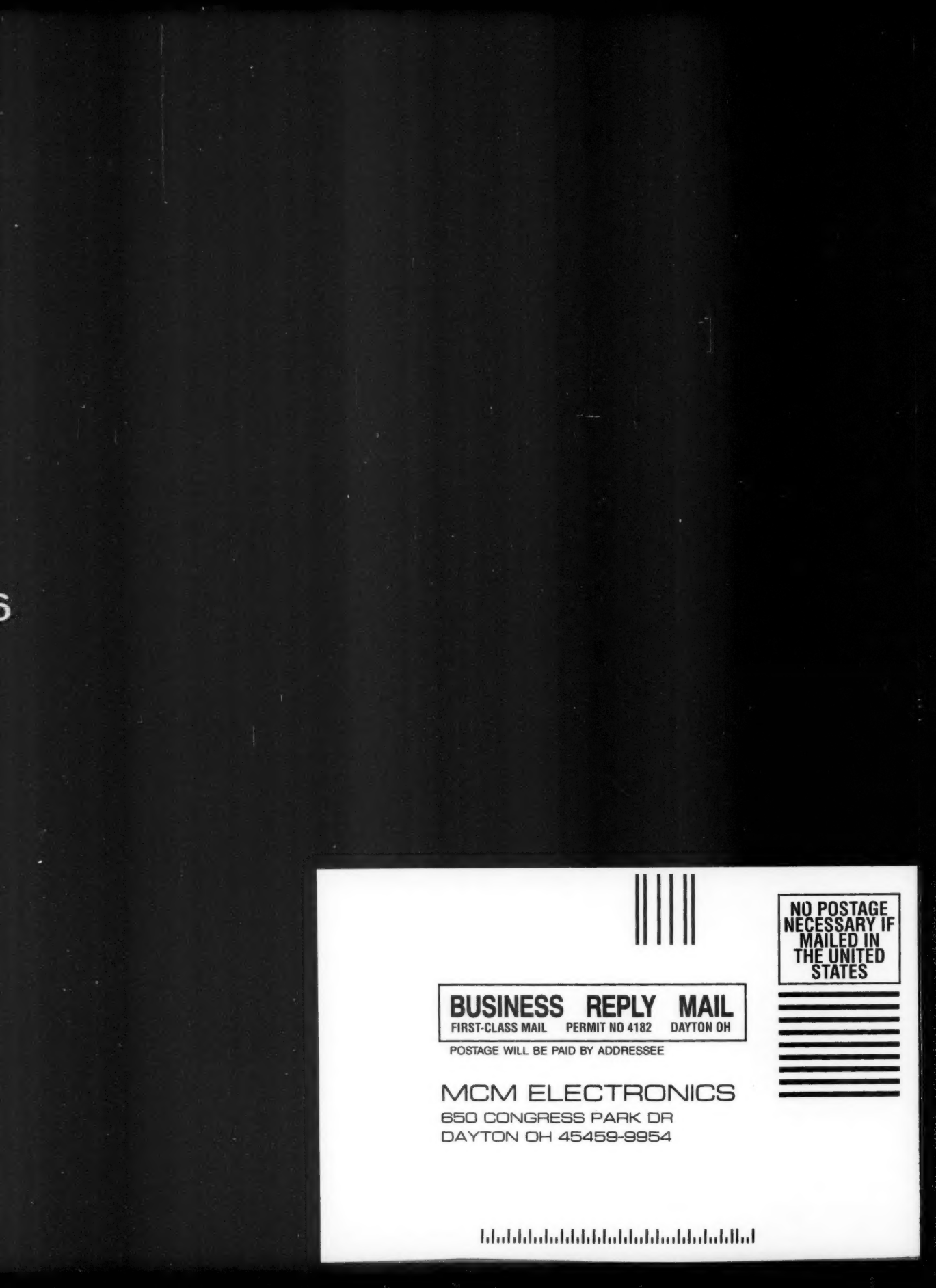
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LETTERS

Continued from page 51

article just before his death. You have published his articles in *73*. Phil wrote the book on solving TVI problems in the early days of TV broadcasting. He demonstrated that TVI-proofing allowed ham transmitters and TV receivers to operate side by side. Even so, he recommended moving the normal TV IF range from 20 to 40 MHz to avoid interference problems. Manufacturers took his advice. We will miss this pioneer. 73

73 needs good ham related cover photos. Call Richard. 603-924-0058

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HAM TO HAM

Continued from page 58

about three feet and into the ground about five feet. The manufacturer's recommended ground radial system was also installed beneath the sod and securely connected to the same pipe, along with a 14-foot commercial-grade ground rod. The need for a good grounding and radial system for any 1/4-wave vertical antenna installation cannot be over-stressed. The outside diameter of this ground pipe is such that the antenna easily slips right down over it, rests on a ring clamp, tightens with a second clamp, and provides a sturdy support for the remainder of the antenna for the time it will actually be up in the air. Remember, it doesn't stay up at all times, only when I want to operate for a while.

The coax back to the indoor radio room in my home is buried beneath the turf about four to six inches, both for protection against damage and for appearance purposes. Make sure that the coax you use is rated for underground applications and that the outer jacket is free of any nicks that might allow moisture into the shield of the inner cable. A quick-disconnect fitting on the coax itself completes the job, but remember to protect this fitting from direct exposure to the weather when not in use.

***Photo B.** KBØSJX positioning his antenna so that it may be dropped over a pipe driven into the ground at the rear of his fenced-in property. The coaxial cable from his shack meets up with the antenna and the "instant antenna-raising ceremony" is complete.*

My "temporary" antenna mount is in back by my property's rear wooden fence, so when my operating time is over, I can simply disconnect the coax, loosen the bottom clamp, lift off the antenna, and hang it from supports attached to the fence itself. The operation takes only a minute or two. The antenna alone is very light in weight, about the same as a heavy-duty deep sea fishing pole...including the bait! The "stored" length along the fence is 18 feet in my case. The photos give you a much better idea of the arrangement that I'm describing. The entire scheme is virtually invisible to the association sleuths for the 90% of the time that I'm off-the-air.

Note: Paul has a nice arrangement here, with possibilities for others in similar circumstances. Photos A and B tell the story best. A hinge-and-lock arrangement might also be helpful (for us older folk) so that the antenna could be "walked" up and down instead of lifted into place, yet it could still be hidden behind the fence when resting in the horizontal position. Such an arrangement might also be used with some of the popular half-wave verticals using a similar design. Lots of "custom" possibilities here; thanks, Paul. By the way, Paul wrote to tell me that he did receive his General...congratulations!

"Green" Is Good!

Here's another tip about an interesting product that's available at most local hobby shops, called Squadron Green Putty®. It's a very quick-drying filler that can be used around the ham shack to fill unwanted holes in panels or cases, or to make a chip or crack virtually disappear in a plastic front panel escutcheon.

That's all for this month. Please keep the ideas rolling in to the address shown in the masthead. And remember, this is your column, where all of the ideas are from one ham to another, which is always the best way! And it doesn't matter how long you've been in the hobby—Paul KBØSJX has been licensed less than one year, yet he saw a workable solution to an common problem. Let's hear from you next month!

Note: The ideas and suggestions contributed to this column by its readers have not necessarily been tested and thus no guarantee of operational success is implied. Always use your own best judgment before modifying any electronic item from the original equipment manufacturer's specifications. No responsibility is implied for any equipment damage or malfunction resulting from information supplied in this column.

Please send all correspondence relating to this column to "Ham To Ham," c/o Dave Miller NZ9E, 7462 Lawler Avenue, Niles, IL 60714-3108, USA. All contributions used in this column will be reimbursed by a contributor's fee of $10, which includes its exclusive use by *73*. I will attempt to respond to all legitimate contributors' ideas in a timely manner, but be sure to send all specific questions on any particular tip to the originator of the idea, not to me or *73*. 73

Every Ham's Average

Continued from page 57

impedance of a solid-state transmitter will very seldom be exactly 50 ohms, although at its rated output power it will be very close.

The problem lies in the fact that the collector impedance of the final amplifier in a solid-state transmitter is very low—about 1.9 ohms for a 100-watt output transmitter operating on 13.8 VDC. To provide a nominal 50-ohm output impedance requires a step-up output transformer which can have only a finite number of turns on each winding. In the case of the 100-watt transmitter the step-up transformer has to transform 1.9 ohms to 50 ohms, or close to it. The transformer requires a 1:25 impedance step-up, from 1.9 ohms to 47.5 ohms. The turns ratio, which is the square root of the required impedance ratio, is therefore 1:5. Because there can be no partial turns on a transformer, there is no way to produce an exactly 50-ohm output impedance with a transmitter producing 100 watts and operating at 13.8 VDC on the final collectors. So, while the indicated power output may differ from that observed into exactly 50 ohms resistive, it isn't anything to be concerned about.

An entirely different thing occurs when this 100-watt transmitter has its output power reduced to 5 watts to operate QRP, which hams do occasionally. With the DC voltage remaining at 13.8 volts, the collector impedance has changed to 19 ohms! The same step-up output transformer with a 1:25 step-up ratio now transforms the 19-ohm collector impedance to about 475 ohms! Although most antenna tuners can match the input to the transmitter output for an SWR of 1:1 or close to it, the wattmeter between the transmitter and antenna tuner is now looking at a 475-ohm load instead of the 50 ohms it is designed for. Thus, the power output indication may, therefore, be in error.

In all cases you should adjust your transmitter to the power output desired into a 50-ohm dummy load, especially at QRPp and QRP levels. Then, regardless of the indications on the RF wattmeter when operating into a load other than 50 ohms, the power output will either be the same or slightly less as long as the SWR is 1:1 or close to it. For all practical cases, consider your power output to be the same as that measured into your dummy load. The ham at the distant station you're in QSO with won't care. 73

Continued on page 63

Every Ham's Average

Continued from page 62

Parts List

C1 22 µF 10V electrolytic capacitor
C2, C3, C4 0.01 or 0.1 µF ceramic disc
D1, D2, D3, D4 Germanium diode: 1N34A, 1N60, 1N90, 1N270, etc.
J1, J2, J3, J4 RF coax jacks, builder's choice
M1 100 µA DM meter
R1 68k ohms 1/4W ±5%
R2 50k ohm trimpot
R3 7.5k ohm 1/4W ±1%
R4, R6 4.3k ohm 1/4W ±1%
R5 33k ohm 1/4W ±1%
R7 75k ohm 1/2 or 1 watt ±1% (See text)
R8 1.2k ohm 1/4 W ±1%

Calibration	Voltage
15	8.66
14	8.37
13	8.06
12	7.75
11	7.42
10	7.07
9	6.71
8	6.32
7	5.92
6	5.47
5	5.00
4	4.48
3	3.89
2	3.16
1	2.24

***Table 1.** Calibration Voltages*

Uncle Wayne's Bookshelf

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Early Radio-In Marconi's Footsteps by Peter Jenson. This is a fabulous 176-page, hard-cover book. Beautifully illustrated, tells the history of radio communications development. Retraces Marconi's footsteps and shows his inventions as he helped develop radio from what had been just a scientific curiosity into a major world industry. Published in Australia, however copies are available from Uncle Wayne's Bookshelf. $40.00 JEN-1

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Mounting and Pointing Lasers

This month I thought I would try to make a big red splash and cover HeNe lasers. For most of us the HeNe or helium-neon laser is just a red glow at the supermarket checkout counter. It's the light source for the price scanner. In some units this could be a diode laser or a tube-type laser. Both of these units emit a bright red beam that is characteristic of a helium-neon (HeNe for short) laser.

The HeNe laser is available in surplus mostly in the 5 to 10 mW power range. Most are used in price checkout stands, laser printers or the older very large industrial printers and some copy machines. Recently we salvaged some lasers by removing them from these types of devices. They were 10 mW laser power heads with focusing optics mirrors and Brag cells. These accessories were used to focus and position the laser beam. The Brag cell is a polished crystalline square structure of lithium niobate. It is this crystal structure through which the laser beam is passed. The cell has two electroplated sets of contacts through which RF energy drives the crystal structure. This drive on the cell structure causes the beam to vary or react to the modulated RF imposed on it (100 mW of power at a frequency of 60 to 90 MHz is normally used). The Brag cell was used to modulate the laser beam for use in printers. Lasers are classified as Type I, Type II, or Type III. The 10 mW laser is a Type III high-power laser and should be used with caution. It carries warnings concerning safety and eye protection.

For safety's sake never look into a laser beam.

Why do we want to use a HeNe for amateur purposes? Well, most things obtained from minimal-budget scrounging-and-foraging missions in commercial and industrial junkyards allow us to have fun with ever-varying surplus electronics that can be quite sophisticated and still inexpensive. By taking advantage of good deals in surplus scrap you can save big compared to buying from your local surplus dealer.

In with the surplus lasers obtained in one batch was a Brag cell laser modulator. The laser, together with the Brag cell modulator, was the mechanism that transferred data to the laser and then to a printed page, in accordance with the printing instructions set. I am not sure just what the original material was, but in any case, as amateurs it is not too important that we know just how a laser printer or copier functions but rather how we can adapt these components to our use.

Most items discarded by commercial industry have a defect of some sort making them unusable to the company. These defects can be overlooked if the device can be made to function in some other-than-normal manner that is still safe and functional.

The remaining metal mount for the laser looked quite bad, but with all the optics still intact with the Brag cell, I decided to use it for my basic laser mount as it was sturdy and allowed some adjustment for laser position.

This mount had a very fine rack-and-pinion that could be used to adjust the laser mounting in respect to the optics. In addition to the rack-and-pinion there was a two-stage ring mount that held another (smashed) glass laser. Now if you are not into weird science and lasers and optics these parts might not excite you. However, if you intend to do any communication with lasers, the need to point with pinpoint accuracy is quite important and the mechanical considerations just as serious.

Electronics in general is my primary interest, delving into which I have expended a great deal of energy and effort. However, mechanical considerations have always left me in the dust, as my primary tools in the early days were a hand drill and a good set of hole punches, with an assortment of files to do the rest of the dirty work. Remember cutting out a meter hole by drilling the perimeter with about 40 small holes and then breaking it out and filing to fit? Well, these techniques don't work with optics; you don't have that tolerance for error.

En Garde!

Take for instance the pointing of a laser at a particular spot. If it's a blackboard or some similar target in the same room you are, this is a simple task. When the distance increases substantially, say, several miles, the pointing becomes quite acute. It's kind of like fencing with a pinpoint sword several miles long. A very small movement at the wrist produces a gigantic movement at the opposite end of the sword. With a laser the scenario is identical. The ability to point with micro-control accuracy is quite important in the mount.

The aiming operation is just the opposite of a microwave dish antenna where dish diameters are in the 30-inch to larger dimensions. Both lasers and microwaves can use gun sighting optics for sighting-in distant objects that track with the main dish or laser beam. At this point some small micro movement is required to acquire the distant object.

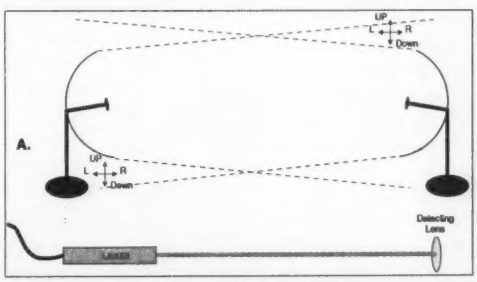

***Fig. 1.** Comparison between laser and microwave systems and their aiming/directional differences.*

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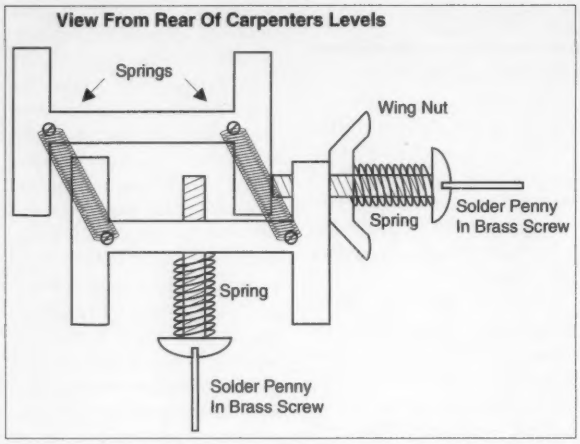

Fig. 2. End section drawing of a laser two-screw positioning mount using two metal carpenter levels.

With lasers it would be to "Drop the spot on the distant detector," and with microwave it would be to "Rock and Lock" one end while the other end reports on the progress of the opposite's moment in signal strength. In the microwave instance, each end of the path can make fine adjustments based on signal strength to each other. By making several of these small angle alignment corrections to the dish orientation at each end of the path several times, you rock the antenna orientation in to each other eventually. See Fig. 1 for aiming concept.

For optical systems, pointing a laser at a target is not quite as simple as in a microwave system. In a laser system, one end must first scan the target to remove errors in point angle, and when the opposite end receives the laser beam of light as detected by its optical receiver, you might be in reverse alignment. That is, the previous receiving station might have good-enough alignment between its receiving optics and transmitting laser to be on (or somewhat close to) transmitting alignment at this time.

In any case, one end must first acquire the other end and then a two-way communications path can be established. Ideally, either end's laser is in alignment with the receiving mechanism, and both are parallel to an exact degree. In the real world some small adjustment is necessary. If the distance is extreme, say, fifty miles versus five miles, then a whole new stance must be taken into account.

At five miles, the typical laser beam diverges or spreads out from a very small spot to one that is about five feet in diameter. This makes it a little easier to point but, still, at even this distance it's not shooting fish in a barrel. There can't be any wobble in the cog here! If you think that hand-pointing a laser will do the trick at paths of a few miles, you need some rethinking. N6IZW and I tried this first-cut "simple" path quite some time ago and found that, with adjustable tripods and with pointer sighting (direct view) to the target, it was not as easy as you would imagine.

The tripod we were using is the same one that is normally used for microwave communications with a large-aperture dish antenna. This microwave conglomeration worked out quite well: signals were so loud that even when the antennas were not pointing correctly we were able to make contact. Pointing the laser using the same tripod showed that a far more accurate pointing mechanism was needed to accurately point a laser at a target. The microwave alignment took about two minutes and the laser pointing took an hour for one-way tests.

The microwave dish pointing arrangements worked well for microwave but were just not capable of the finer resolution needed to aim the laser beam properly at the target. True, we finally succeeded but with lots of effort and meticulous pointing adjustments continuously being made at the laser end of the path. To bring home this point, examine a yardstick lashed securely in the middle (18-inch point) to a good heavy tripod. Now imagine tapping one end ever so lightly with a pencil point and watch the effect on the other end. With a stick or laser beam five or even fifty miles long you're looking at a movement like a freight train passing by. The basic mount has to be very sturdy and some magnitude sturdier than a very good microwave tripod. In a 50-mile laser contact, I would suggest using a metal lathe table as the optical bench stand.

For contacts in the five-mile range, simpler equipment can be employed. The basic microwave tripod can be used for basic pointing. Then the mount attached to the tripod base that houses the laser and rifle spotting scope and receiving photo detector must all be capable of individual fine adjustment. This adjustment scheme is independent of the tripod adjustments. The finer-adjustment mechanism needs to address vertical- and horizontal- position movement. I would suggest looking for something to which a very fine-pitched screw or micrometer can be attached, to handle the final pointing attitude adjustment. See Fig. 2, which covers the two-screw adjustment technique.

In its simplest form a fine-pitched screw can be used with a counter spring in both the vertical and horizontal planes. The counter springs are used to load the screw properly to prevent backlash movement. What type of screw is best? Well, any one with fine threads will work but the finer the better. What I would suggest using would be something that would mimic a commercial micrometer shaft and dial mechanism, or using two inexpensive micrometers themselves may be the best choice. Check out old WWII microwave generators for klystron tubes, as some had micrometers attached to them for tuning. If you decide to purchase them new, hold on to your hat—they cost $50 to $60 each.

I would prefer to try swap meets to locate old worn or used micrometers, even when too worn for industrial use. We want their fine-threaded mechanism for position accuracy, not measurement. In any event, exactly what you use is not important. Just use a device or screw that has a fine-pitch thread, allowing you a fine movement as the screw is turned against its stop.

I have seen two metal levels used for the laser table mount, with one end fixed and the other end with the vertical/horizontal screws and springs for position control. It's simple and quite inexpensive for experimentation, constructed from two wide "H" frame aluminum levels. One level is set on top of the first level, offset by the "H" frame. See figure 3 for the end view of the two levels. So much for the mount. What types of lasers are available in the surplus market?

The typical Helium Neon (HeNe) laser comes in two styles: a glass tube, and a "head." The basic laser is a glass tube with suitable mirrors on either end and high-voltage clips to attach to the tube for connection to the power supply. When this glass tube is enclosed within a metal container it is called a "head." The glass-tube laser and its high-voltage connections are protected by the metal tube. Usually the high-voltage is tied common to the metal tube as a system ground. Because of voltage in the 1000 or more volts needed to operate lasers, be very cautious and use proper grounding techniques.

There does not appear to be any method of determining what power a laser is by just looking at the device. However a 10-mW unit can be generally regarded as larger in comparison to a 1-mW unit from the same manufacturer. Most of the 10-mW units that I have been able to pick up in surplus are about 16 to 18 inches long and 1-3/4 inch in diameter. They come with a shutter for the laser output end and a shielded cable for power supply connections.

Don't short-circuit yourself: remove the cable connector. It's a special high-voltage connector that is polarized, allowing the proper potentials to be applied to the laser head. Additionally, by being polarized it maintains system ground to the laser head tube.

Continued on page 72

Welcome Newcomers

Join the ARRA

Wayne Green W2NSD/1

You've been nominated to be a member of the ARRA. So what's the ARRA, a new national ham group? Yep, one with no officers to sit in high places and look down benevolently on us peons, no directors to pass on the pronouncements from the officers, no dues you can't afford, and not even any bylaws to keep out the unwelcome. It's the Amateur Radio Rescue Association, so try as best you can not to confuse it with the ARRL, a Morse code radio relaying group.

Your sole duties, if you sign up as a member of the ARRA, will be to get on the local repeaters and do your best to convince the no-coders that there really is life below 144 MHz. We've got to somehow convince these guys to go for their General tickets...to rescue them from their lonely outpost on 2m. Get those hermits out of their caves and into our ham society. Just think, they may even be missing those endless self-promoting sermons from K1MAN!

When I saw the FCC figures showing the license figures for the last 10 years (see page 65 last month for the bad news), and I saw that despite the explosion of Techs there had been not even the slightest budge in the growth of the higher class licenses, I knew (a) that my efforts with *Radio Fun* to get Techs to upgrade had totally failed, and (b) that the rest of us have not been making a serious effort to get them to upgrade. We now have well over 350,000 Novices and Techs, over 90% of whom have shown no sign of making any effort to upgrade.

This means a couple of bad news things for the AGE group (Advanced-General-Extra). First, it means that one of these days the FCC may possibly notice that the Tech license has totally failed in its whole excuse for being. And this could easily trigger some rethinking of the amateur service, which is right down there at the bottom of the things we want the FCC to think about. Second, it means that when you normalize those "growth" curves by taking into consideration the almost 50% dropout of licensees when that 10-year renewal time finally arrives (through Silent Key-ism, boredom, other priorities such as the XYL and harmonics, job changes, or an interest in newer and more exciting hobbies), we're actually dwindling in numbers. But anyone who's been hamming for a few years recognizes that the bands are noticeably less populated than they used to be. The pileups are more like small heaps. The DX lists are shorter. And the lack of sales of new equipment has the manufacturers and dealers wringing their hands in panic.

Get 'em involved with your club and then put on demonstrations of HF packet, slow-scan, RTTY and all the other good stuff we have to keep 'em busy for a few years. If you're properly geared up, contests can be a blast. I had a ball in the Sweepstakes for many years. Ditto DX contests, VHF contests, and so on. Get 'em interested in certificates. Get your DXers to show off their cards. If you have any DXpeditioners around, have them put on a slide or video show of their recent DXpeditions.

"Get 'em involved with your club and then put on demonstrations of HF packet, slow-scan, RTTY and all the other good stuff we have to keep 'em busy for a few years."

A Call To Action!

Your help is desperately needed to turn this disaster around. Your help is needed to get up on 2m and convince the new permanent residents that there really are some fun things to do on the HF bands. Keep on talking about what you've been doing on the other bands. The interesting nets on 75 (yes, there are some), the DX on 20 and 40. The openings on 15 as the sunspots blossom.

Let's get more of our repeaters to work crossband to the low bands. I used to have WR1AAB, my repeater on Pack Monadnock, so it would crossband to either 6m and 10m. It's no big deal to do, but it sure does give the 2m hermits a little peak into the outside world. Maybe you can organize groups in your club to beat the 2m bushes and get the Techs to come to meetings where you can help them upgrade with tech sessions and maybe even some 13-per code. If you teach 'em 13-per my way, they'll learn it in a fraction of the usual time and avoid entirely that incredibly frustrating 10 wpm plateau.

But the main thing is to invest some time on 2m and help pry the barnacles loose from the repeaters and get them to upgrade. Treating 'em like CBers will alienate them and they'll soon be everything you dread. No, you've got to get up there and mix in and do your selling job.

If you know anything about selling, you understand that to sell you have to point out the benefits to your customer of the product you're selling. Thus, instead of putting Techs down for being lazy, keep at 'em on the fun they're missing. If you can't set up some crossband contacts to give them a taste, at least play some tapes of DX you've worked. Brow-beating won't work. Shame won't work. Being nasty sure won't work. Those are proven ways not to sell. Pictures of $100,000 shacks on the cover of ham rags isn't much of a turn-on either. Look, if the Techs on 2m act like CBers, it's you who's made it happen, either by not talking them down to the HF bands, or by being unfriendly on 2m.

Sure, there are some real jerks on CB. But if I were just getting interested in radio communications, that's where I'd head to start. And I've had endless wonderful contacts on CB. I find that often I have a better chance at talking with people on CB than I do on 2m when I visit a city. On 2m I'm either frozen out by a closed repeater or ignored when I call in. Hello, is anyone there? Not often.

You personally can do more to help keep amateur radio alive if you join the ARRA and proselytize the HFs to our increasingly alienated Techs. Maybe we should organize some merit badges for successful Generalizations of Techs. I'll be watching the club newsletters for word of 2m rescue activities. Oh yes, one more thing, please call your club secretary and get him or her to put me on their mailing list. I want to keep track of what your club is doing. Or not doing. Wayne Green W2NSD/1 - 73 Magazine - 70 N202 - Peterborough NH 03458-1107. Please don't disappoint me.

And if I see a mention of the ARRA in the club newsletter I'll send one of my free prize subscription offers to the club. Yes, that's a bribe. 73

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Communications Simplified, Part 2

Peter A. Stark K2OAW
PO Box 209
Mt. Kisco NY 10549

After our introduction to sound and audio in the first part, we now continue with pictures and video.

Video

You can send pictures through communications in various ways, but the most common means today are fax machines and television. So let's talk about those.

Fax Machines

Twenty years ago, fax machines were very rare, though not entirely unknown. Currently, almost every office has at least one fax machine.

Today's fax machine can send letters, pictures, cartoons, photos, and almost anything that you can feed through its slot. Shown in Fig. 1, the typical machine consists of five parts: (1) a scanner that can scan a printed page and convert it into an electrical signal; (2) a printer that can take such an electrical signal and print it on paper; (3) a telephone and dial by which to call other machines;(4) a modem that couples the digital circuitry to the telephone line; and (5) a microprocessor that ties it all together and makes it work.

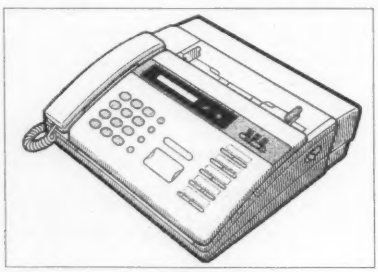

Fig. 1. A typical fax machine.

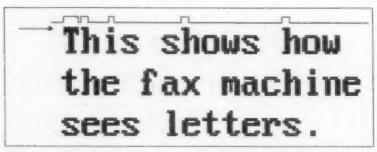

Fig. 2. Enlarged view of some text being sent.

Since the fax machine contains both a scanner and a printer, it can usually be used as a copier; that is, it can scan one piece of paper, and at the same time create a copy of it in the printer. But that's a secondary function. Its main purpose is to transmit that page through the phone to another machine.

To begin the process, you insert the page you want to send into a slot on the fax machine (the slot is on top of the machine illustrated), pick up the handset, dial the number of the machine you want to reach, and wait for the call to go through.

When the called machine answers, it sends back some tones whose purpose is to let your machine know that the connection has been made. When you hear these, you generally press a START button, hang up the handset, and wait for the call to finish.

Let's skip ahead to this point, and look at how your fax machine scans the page you want to send. Fig. 2 shows an enlarged view of some typewritten text that we want to send.

When you push the START button, a photosensitive scanner head starts to sweep across your page, from left to right, starting at the upper left corner. The small arrow at the top left of Fig. 2 shows where the scanner starts and the direction in which it moves. It never sees your entire text; rather only the narrow area of white and black over which it passes. Also, the scanner sees only the tops of the letters "th" and the top of the dot over the "i" (as well as the tops of the two "h"s farther on the right), since all the other letters are shorter. As it scans from left to right, it sees the dark areas shown in Fig. 3.

This is an important concept to understand: The fax machine doesn't actually try to read the letters themselves. It only looks at the patterns of white and black. In other words, your page could contain English, Chinese, or Russian letters, drawings, or chicken scratchings. Only the patterns of light and dark are sent.

As the scanner goes across the page, it outputs a waveform like that shown at the top of Fig. 2. This is a digital signal that shows a low value of voltage when the scanner is passing over white paper, and a higher voltage when it passes over black ink. Although more expensive fax machines can handle grays, the typical cheap fax machine doesn't sense differences in grays. If a gray is light, it's treated as if it is white; and if it's dark, then it's assumed to be black.

As the scanner head is moving right, its output is sent to the microprocessor as a digital signal. When the head reaches the right margin, the microprocessor goes to work; meanwhile, the head returns back to the left and the paper moves up about 0.005 inch. Eventually (after the microprocessor has finished processing this signal), the head will start another sweep across the page, but this time about 0.005 inch lower down on the paper. It will then scan another strip of text, and so on, until it eventually reaches the bottom of the page. In this way, the 11-inch height of the paper is divided into about 2200 strips, each about 1/200 of an inch high (that's equal to 0.005 inch), and each strip is scanned for light and dark areas across the width of the paper.

Fig. 3. What the fax scanner sees.

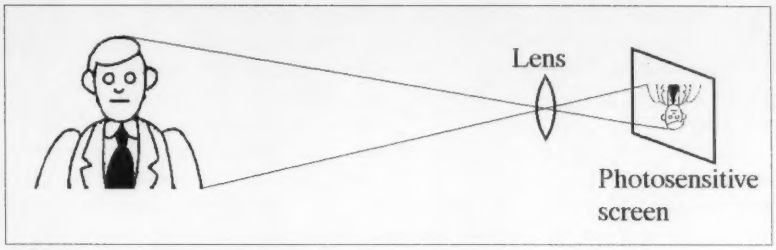

Fig. 4. *A simplified black-and-white TV camera.*

But let's return to the microprocessor, which gets the signal shown at the top of Fig. 2. This signal has only two voltage levels (assuming we're dealing with an inexpensive black-and-white fax machine.) A digital signal like this can't be directly sent through the telephone line; besides, it would be inefficient to do so. And so the microprocessor analyzes the signal and sends a *description* of the signal, rather than the signal itself.

The microprocessor measures distance on the paper in *pixels* rather than inches; each pixel being 0.005 inch. (A typical fax machine actually has a fine mode and a coarse mode, depending on the sharpness and detail you want. I am using the numbers for fine mode in this description.) The word pixel is an abbreviation for *picture element,* and it is the smallest spot that the fax machine can see or print. If you look at the printout in Fig. 2, you can see that the letters look as though they are made out of square blocks; these are the pixels. The 8.5-inch width of the paper is therefore about 1700 pixels wide.

As the microprocessor receives the signal from the scanner head, it counts off the number of pixels of white and black, and generates a description of the signal in terms of pixels. For example, if it sees an entirely blank sheet of paper, it simply sends a message to the other machine that there are 1700 white pixels. On the other hand, if there is a lot of printing on that line, the description might read:

- 10 white pixels
- 3 black pixels
- 17 white pixels
- 7 black pixels
- 12 white pixels
- 9 black pixels, etc.

You can see that the description of a blank line is a lot shorter than the description of a line with a lot of print. Hence, how long it takes to send a page depends on how much writing is on it. A blank page might feed through in 10 or 15 seconds, an average letter might take 30 seconds, or a page of newsprint might take almost 2 minutes. You can notice the difference as you watch the machine send or receive a page. Blank or nearly blank pages feed through at a speedy clip; complex pages feed through in tiny spurts.

The advantage of sending descriptions rather than the actual waveform is that *for an average page* this takes less time than would sending the actual waveform.

At this point, it doesn't pay to delve much deeper into the fax machine, since my primary purpose in discussing fax machines is to lead into a discussion of TV; let's just say that the description coming out of the microprocessor is itself a digital message. Since the telephone line is not able to carry digital data directly, a *modem* converts the digital data into tones that are then transmitted through the line. The word modem stands for *mo*dulator/*dem*odulator, the device that converts (modulates) data to tones on one end, and then changes (demodulates) the tones back to digital data at the other end.

Before moving on to TV, let's just summarize: The fax machine divides the printed page into horizontal strips about 0.005 inch high (and therefore about 2200 strips per 11-inch page), and scans each strip from left to right. The black/white information from each strip is sent from the sending machine to the receiving machine, but as a description rather than as the data itself. It takes anywhere from 10 seconds to perhaps 2 minutes to send a page, depending on its complexity, which means that the time to send the information for one strip takes anywhere from 10/2200 second (about 0.005 second) for a near-blank page, up to about 120/2200 second (about 0.06 second) for a fairly complicated page. In terms of what we learned about bandwidth in Part 1, it takes a fairly long time to send the picture an therefore not much bandwidth is needed.

Television

Let's summarize normal TV in terms similar to what we just did for fax machines. The TV camera divides a picture into 525 nearly-horizontal strips (the height of the strip depends on the sizeof your TV screen), and scans each from left to right. The information, which includes not just black and white but also grays and colors, is sent as the actual waveform, not as a description. Regardless of how complex, light, or dark the picture is, it takes the same 1/30 of a second to send that waveform. Furthermore, in order to provide the feeling of motion, the TV camera sends 30 complete pictures per second. As you can guess, the bandwidth for a TV signal must be much higher than that of the fax signal.

Let's look first at what the TV camera does. Fig. 4 shows how a lens focuses an image of a person onto a photosensitive plate inside the camera. In studio cameras, that photosensitive plate is inside a vacuum tube called an *iconoscope.* Older home cameras used *vidicons,* whereas the latest home cameras use charge-coupled devices (CCDs). Either way, the photosensitive screen gets an upside-down image of whatever the camera is pointed at. This image is then split into strips and scanned.

In an iconoscope or vidicon, that scanning is done by a thin electron beam, which is aimed at the screen; in the CCD, the screen is itself divided into tiny spots, each of which can measure the amount of light hitting it, and electronic circuitry then interrogates each spot to see how much light it got. Since the studio cameras use iconoscopes, I will talk about the beam as doing the scanning.

As in the fax machine, scanning is done from left to right, and top to bottom of the picture. But since the picture in the TV camera is upside down, in the camera it starts at the bottom right, and goes from right to left, and bottom to top, as shown in Fig. 5.

You'll note that, unlike in the fax machine, the strips in the TV camera are not exactly horizontal. There is a very slight tilt to them, because as the scanning goes

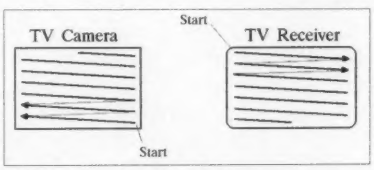

Fig. 5. *Scanning in the camera and receiver.*

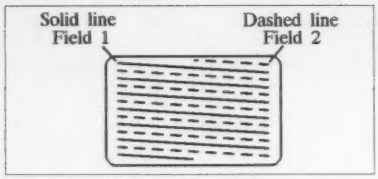

Fig. 6. Two fields make a frame.

from side to side, it is also moving upward, although much more slowly. You can also see a thin line, called a *retrace* line, which shows how the beam jumps from the end of one line to the beginning of the next.

Fig. 5 also shows the beam as it moves in the picture tube in your home TV receiver. Here again, you will note that there is a slight tilt to the lines,. but here the scanning starts at the top left, and so the beam moves slightly down as it moves right. What is impressive about the whole setup is that the beam in the camera is exactly synchronized with the beam in not just your TV set, but also the beam in every single other set that is tuned to the same station. At the exact instant that the beam is at the bottom right corner of the camera screen, it is at the top left corner of possibly millions of TV sets around the country. This must be so to make sure that an item in any particular spot of the picture shows up in the corresponding spot on the screen!

Let's return to Fig. 5. The correct name for what we have been calling strips is actually *scan lines* or *sweep lines*. We mentioned earlier that there are 525 strips in the picture, whereas Fig. 5 shows only 6-1/2 lines. What actually happens is that the 525-line picture (also called a frame, named after a frame of movie film) is divided into two 262-1/2-line fields. The first field of each frame ends on a half-line at the bottom, while the second field of that frame begins with a half-line at the top. This is shown in Fig. 6, though obviously the space is not available to show all the lines.

You will note how neatly the lines of field 2 fit between those of field 1. This process is called *interlacing*, so that a normal TV picture is said to be *interlaced*.

To understand why interlacing is needed, let's consider movie film. In order to show motion on the screen, the movie projector projects a series of slightly different frames on the screen, at the rate of 24 frames per second. But if the projector lit up the screen just 24 times each second, most of us would be badly annoyed by the flicker. So the projector actually puts each frame on the screen twice, for a total of 48 "flashes" per second.

Television has a similar problem. It transmits 30 complete frames per second, but to avoid flicker has to light up the screen more often than that. It is not really practical to flash each frame on the screen twice, because then either the TV transmitter would have to send each frame twice (which would require more bandwidth) or else the TV set would have to store each frame in an internal memory so it could display it a second time (which wasn't practical decades ago when TV was designed.) So television was designed to transmit each frame in two halves—the two fields, with 60 fields per second.

Note that storage of frames was not practical years ago, but the prices of memory circuits have dropped to the point where it now is. Most computer monitors (which work on the same principles as those of a TV set), therefore, do not use interlacing.

So let's put some of the numbers back together:

- There are 30 frames per second. (In a color picture, there are 29.97 frames per second, or 0.1% less.)
- There are 60 fields per second (or 59.94 fields per second in color). This means that the electron beam moves up and down 60 times per second in the picture tube.
- Each frame contains 525 interlaced lines, or 262-1/2 lines per field.
- The 525 lines of a frame repeat 30 times per second, so there is a total of 525 X 30, or 15,750, lines per second. Thus the electron beam moves left-right a total of 15,750 times per second (which drops slightly to 15734.25 with color.).

Remember that the beam motion must be completely synchronized between the camera and all TV receivers watching that channel to make sure that all objects appear in the right place on the screen. Making all of these beams move together requires that the beam motion circuitry in every TV set is synchronized with the camera. Let's look at Fig. 7, which is a very simplified block diagram of a typical black-and-white TV set.

The signal coming in from the antenna goes through a box labeled "Tuner, etc." There is actually a lot of circuitry in this box; however, because we're not nearly ready to discuss it, let's just say that this is where the signal is amplified, and the particular channel is selected. The signal then goes into the video detector, whose output is a signal called *composite video*. This signal is in turn sent to the sync separator, which separates the composite signal into three parts: video, horizontal sync, and vertical sync.

The video signal contains the actual picture information, including whether a particular pixel should be light or dark; it also tells what color that pixel should be, except that we are limiting ourselves to a black-and-white TV for now. This signal is amplified by a videoamplifier and sent to the picture tube.

Meanwhile,. a beam of electrons travels from the electron gun to a layer of phosphor material on the screen. Whenever the electron beam hits the screen, the phosphor material lights up to produce a visible spot. You can vary the brightness of that spot by changing the strength of the beam; that in turn is controlled by the video signal from the video amplifier.

The motion of the electron beam (or beams in color) is controlled by the horizontal and vertical *deflection circuits*, which consist of two oscillators, two amplifiers, and the *yoke*.

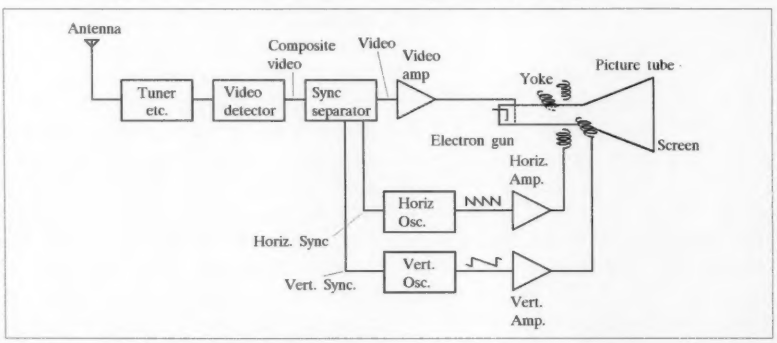

Fig. 7. Black-and-white TV block diagram.

The horizontal oscillator produces a sawtooth wave at a frequencyof 15,750 Hz. This signal is amplified by the horizontal amplifier, and sent to a pair of coils in the yoke. The yoke looks like a doughnut-shaped ring that is slipped over the neck of the picture tube. It contains four coils that produce a magnetic field as current flows through them. Two coils, positioned above and below the neck, move the beam left and right, while the other two move it up and down.

DETOUR

Detour 1

We've been avoiding discussing color for awhile, but since we have to cover it eventually, here goes.

In a color set, there are three video amplifiers and three electron beams in the tube, one for each of the three colors (red, green, and blue.) There are also three color phosphors on the screen, with a "shadow mask" behind the screen that masks the screen so that the red beam can reach only the red phosphor, and so on.

If you look at a color set's screen with a magnifying glass, you can see the tiny color dots (or sometimes stripes) that make up the picture. But if you lean back, the tiny color dots blend together into other colors. For example, when a red dot, a green dot, and a blue dot are all lit up next to each other, from a distance their colors add up to produce a white dot. A red dot and a green dot together, without blue, produce yellow. The various colors on the screen are thus put together out of various combinations of tiny red, green, and blue dots.

Normally, all three electron beams move across the screen together, but their intensity varies depending on what the color is supposed to be at that point.

END OF DETOUR

The sawtooth horizontal sweep signal is sent to the two horizontal deflection coils in the yoke. The sawtooth voltage sweeps the beam from left to right, and then suddenly swings it back to the left (the retrace) in preparation for the next sweep line. Since the beam is normally turned off during that retrace sweep, it can't be seen during that return trip.

Meanwhile, the vertical oscillator produces another sawtooth wave, but this one at 60 Hz. It too is amplified, and then sent to the vertical deflection coils in the yoke. It sweeps the beam slowly down

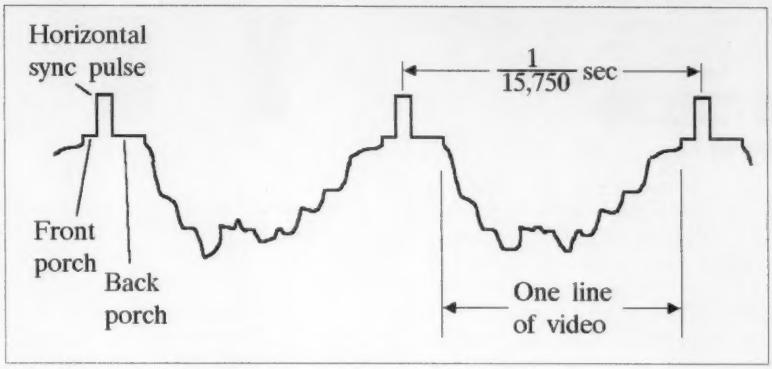

Fig. 8. Composite video signal.

(in about 1/60 of a second), and then rapidly returns it to the top. Again, the beam is turned off during this retrace, but if you turn up the brightness on your set, you may be able to see the beam as it returns to the top. (Actually, it doesn't return to the top fast enough, so you can see it swing back and forth a few times as it returns to the top.

The two oscillators run even if you don't tune in to a working channel. This makes sure that the beam continues sweeping across the screen, rather than settling in the middle of the screen and burning the phosphor at that spot because of too many electrons. But they may not run at exactly the right frequencies, since the components in the oscillators are not precise enough to maintain the right frequencies themselves.

The job of maintaining the exact right frequencies and phases is handled by the horizontal and vertical synchronization (sync) signals, which come from the sync separator. These sync signals originate at the TV studio (typically, a single sync generator in the studio would feed all the cameras to make sure they all sweep at the same time; this is required to allow smooth switching from one camera to another), and are transmitted as part of the TV signal. The sync separator strips them from the composite video signal and sends them to the appropriate oscillator.

Let's return now to the composite video signal, the signal that comes out of the video detector in Fig. 7 to the sync separator.

If you look at the composite video signal with an oscilloscope, you see a signal that looks something like Fig. 8.

Fig. 8 shows three horizontal sync pulses, each separated by 1/17,500 second, the time for one horizontal line. Each of the pulses sits on top of a *pedestal*, which consists of a *front porch* and a *back porch*. The jagged line between any two horizontal sync pulses represents the video signal for one sweep line. As this figure shows, two consecutive sweep lines are generally somewhat similar to each other, though not identical, because they are essentially almost-adjacent strips of the same picture. (I say "almost adjacent," because they are separated by one strip from the interlaced second field.)

The voltage of the video information represents the brightness (also called the luminance) of the picture. In Fig. 8, black is up, near the sync pulses, while white is down, and there are various shades of gray between. This polarity makes the most sense when we talk about a pedestal; keep in mind, though, that most transistor amplifiers invert their signal; thus, depending on where you connect the oscilloscope, the signal may be either as shown in Fig. 8, or upside down (with the sync pulses pointed down, and white being up.) For example, the standard output of a VCR's or camcorder's VIDEO OUT jack is an upside-down signal, with the tips of the sync pulses being down at 0 volts, and the white peaks of the video signal at approximately +1 volt.

A vertical sync pulse occurs once every every 262-1/2 horizontal sync pulses.The shape of this sync pulse depends on the circuit that generates it. In commercial TV, it looks like a half-dozen horizontal sync pulses strung together, with some extra short pulses before and after them; this is often called a *serrated* sync pulse (like the serrations in a steak knife.) In computer monitors (which are usually not interlaced and in which timing is not as crucial), the

vertical sync pulse is often just a single, but very long, pulse.

DETOUR

Detour 2

In the absence of the sync signals—for instance, when you're not tuned to a working channel—the vertical and horizontal oscillators "free-run," meaning that they oscillate without being synchronized to a station. If the free-running frequency is not close enough to the frequencies required by the station, however, the sync pulses may not be able to synchronize them. Hence, most TV sets have a pair of controls, called VERTICAL HOLD and HORIZONTAL HOLD, which bring the free-running frequency into range. You may have noticed what happens when you misadjust these controls.

When you turn the VERTICAL HOLD control off its normal setting, the vertical oscillator's normal frequency varies out of range of synchronization, and the oscillator suddenly oscillates at the wrong frequency. When this happens, the vertical position of the picture will be wrong, and it may roll up or down, depending on which way the control is set.

When you turn the HORIZONTAL HOLD control away from its normal setting, the horizontal oscillator changes to a different frequency, and parts of the picture move left or right. This normally slides the picture sideways and then suddenly tears the picture into diagonal bars.

In addition to VERTICAL SIZE and HORIZONTAL SIZE controls (which vary the gain of the vertical and horizontal amplifiers to make the picture larger or smaller), many TV sets also have a VERTICAL LINEARITY control. This control changes the shape of the sawtooth vertical sweep control, and results in the top of the picture stretching or shrinking a bit. This control is normally set to make people's heads appear the right size.

END OF DETOUR

The pedestal looks somewhat different in a color signal, because the back porch contains nine cycles of a 3.579545-MHz signal called the *color burst*. The color information is carried on a 3.579545-MHz "subcarrier" (we will define that word later) and the color burst is used to synchronize a color oscillator in the TV set. (If you've seen cheap 3.579545-MHz crystals in the Radio Shack catalog, now you know where that crystal is used.)

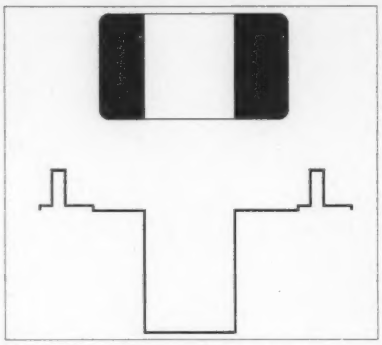

Fig. 9. A TV picture with one white bar.

Bandwidth

Let's return to the question of bandwidth of a TV signal. Suppose we aim a TV camera at a black sheet of paper containing a thick, vertical white bar, and look at the resulting composite video signal; we will see something like Fig. 9.

The top of Fig. 9 shows the screen, while the bottom shows one line of the composite video signal. Since the picture is identical from top to bottom, all the scan lines will look the same.

What we now want to ask is this: What is the spectrum of the composite video signal?

With some fancy mathematical analysis, we could come up with an exact answer. But we needn't go that far if we're willing to accept an approximate answer instead of the exact numbers. Looking at the video signal, we see a signal that, except for the horizontal sync pulse, would look like some sort of a square wave. Its frequency is 15,750 Hz, the same as the frequency of the sync pulses. Since the sync pulse is relatively small compared with the rest of the wave, ignoring it will produce an error in our answer, but not a tremendously large one.

But we already know what makes up a square wave: a fundamental plus odd harmonics. Hence, this signal consists of a 15,750-Hz fundamental, plus harmonics at multiples of 15,750 Hz (but, since the signal is not exactly a square wave, there will also be even harmonics). There will (at least theoretically) be an infinite number of harmonics; however, after the first 100 or so harmonics, their amplitudes will be so small compared with everything else that we might as well forget about them.

Let's now increase the number of bars from one to three, as in Fig. 10.

As before, we can again approximate this signal with a square wave (and even more accurately, because the sync pulses are now even smaller than all the rest of the signal), but this time the frequency is three times higher than before. A square wave with a frequency of 3 x 15,750 Hz, or 47,250 Hz, now consists of a fundamental frequency of 47,250 Hz, and odd harmonics starting at 3 x 47,250 Hz.

In the same way, we could extend our process to as many bars as we want. For example, if there were 300 vertical bars on the screen, then the fundamental frequency of the square wave would be 300 x 15,750 Hz or 4.725 MHz, and the harmonics would start at approximately 14 MHz.

There is only one problem with this idea. If you look at Fig. 2, you see that the received TV signal has to go through the box labeled "Tuner etc." And this part of the TV set generally has a maximum bandwidth of about 4 MHz (depending on the set, with color sets being somewhat worse than black-and-white sets.) In other words, our TV picture with 300 vertical bars will not get through that part of the set because even the fundamental frequency, the lowest frequency in the video signal, lies above 4 MHz!

Even a picture with just 100 bars would have some difficulty. Its fundamental frequency of 1.575 MHz would make it, but even the lowest harmonic, at 4.725 MHz, would not. In other words, the square wave video signal would be reduced to a sine wave. As a result, the signal would gradually change from white to black, or from black to white; on the screen, the edges of the bars would appear blurred.

The bandpass of the "Tuner, etc." part of the TV set puts, therefore, a basic limit on the number of vertical bars we

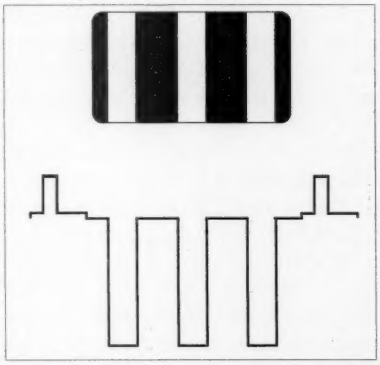

Fig. 10. A TV picture with three white bars.

can display, sharply or not. This limit varies with the set, but is about 250 lines.We call this the horizontal *resolution* of the TV picture.

It happens that the vertical resolution of a TV set is also about 250 lines. Of the 525 sweep lines on the screen, a bit under 500 actually appear on the screen (the others are either above or below the borderof the screen, or else occur while the beam is returning from the bottom back to the top). If these 500 or so lines alternated between one white, the next black, and so on, then the maximum we could get would be about 250 white lines separated by 250 black lines.

It *is* possible to get somewhat better than 250 lines of horizontal resolution on a TV screen, but only by bypassing the "Tuner, etc." portion of the TV set. Many TV sets permit that by having a composite video input jack, or even better, separate connectors for video and sync signals. Many camcorders, VCRs, and laser disks offer better than 4 MHz bandpass, and can therefore provide a sharper image, but only when they are connected directly to these special video input jacks.

Bandwidth thus affects not just the sharpness or resolution of theTV picture, but also the speed at which TV pictures can be sent. The number of lines could be increased either by increasing the bandwidth or by slowing down the transmission so that the entire horizontal line would take longer. For example, the fax machine achieves much greater horizontal resolution at a lower bandwidth by taking more than 1000 times as long to send one line of video.

Or consider TV pictures sent back from a spaceship to Jupiter. Since a wide-bandwidth signal picks up much more noise, space TV signals are sent at a very low bandwidth to minimize this noise. As a result, they must be sent very slowly to maintain any reasonably good resolution. It often takes several minutes to get one picture.

Color TV

When color TV first started, there were very few color receivers, and very few stations transmitting color. So color TV was originally designed to be completely compatible to make sure that customers with black-and-white sets could receive the color stations, and vice versa.

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In color TV, everything happens exactly 0.1% slower; there are 29.97 frames per second instead of 30, and the horizontal frequency is 15,734.25 Hz instead of 15,750 Hz. So the composite video signal consists of 15,734.25 Hz and its harmonics.

Let's take a look at two specific harmonics: the 227th harmonic (at 227 x 15,734.25, or 3,571,674.75 Hz) and the 228th (at 228 x 15,734.25, or 3,587,409 Hz). Neatly sandwiched between those, at 3.579,545 MHz, safely out of the way so it won't interfere with either harmonic, is an added signal called the *color subcarrier*. This is a weak signal, carried as part of the color composite videosignal, whose phase at any instant tells the color TV set what color to make the screen at that instant. (A modern black-and-white TV ignores this signal, though early sets used to display a tiny herringbone pattern on the screen when watching a color signal.)

We've already mentioned the color burst signal, a short burst of 3.579545 MHz that sits on the back porch, just after the horizontal sync signal. The color set has an internal 3.579545 MHz oscillator; the color burst synchronizes this oscillator so it is in phase with a master color oscillator in the TV studio. To decide on the exact color to put on the screen, the set compares the phase of this local oscillator with the color subcarrier.

Digital TV

The method we've described up until now is called the NTSC method, named after the National Television System Committee, which defined the method back in the 1950s. It is purely analog; that is, no digital computer circuitry is involved. Keep in mind that computers were in their infancy, and very, very expensive at that.

In 1990, however, while the FCC was considering establishing a new TV service called HDTV, or High Definition TV, a proposal was made for an entirely digital system. Several other companies jumped on the bandwagon, and the current HDTV system design comes from a group called the Grand Alliance: AT&T, General Instrument, MIT, Philips, Sarnoff (the old RCA Laboratories), Thomson, and Zenith.

The Grand Alliance team was formed after several different groups proposed several different (and incompatible) schemes. Rather than give anything up when they merged, they incorporated everything into the final HDTV proposal. So the HDTV system includes six picture formats:

frames/sec	scan lines	resolution	interlaced
60	720	640	no
24	720	640	no
30	720	640	no
30	1080	960	yes
24	1080	960	no
60	1080	960	no

Table 1.

The rationale for including all six formats is that different formats could be used for different types of programs. For example, movies (which run at 24 frames per second) would not have to be converted to 30 frames per second, as happens now.

The HDTV system also includes five channels of sound for stereo and surround sound, and even provisions for extra data channels for sending computer data.

If all of this were done with analog methods, the bandwidth would be much larger than current NTSC television, which would mean a reduction in the number of TV stations allowed. But sending the pictures digitally allows digital compression methods to be used. For example, since two consecutive picture frames tend to be very similar, TV stations could transmit just the differences between them. The digital circuitry in the receiver would then insert the changes into the preceding frame, stored in digital memory, to make the new frame.

As a result, the complete HDTV picture would fit into the same channel format as current TV. Although you would need a new (and much more expensive) TV set to receive HDTV, there would be a period of transition when both NTSC and HDTV stations would transmit at the same time. The hope is to be able to sandwich HDTV signals into the unused channels between current NTSC stations, without causing interference in either direction.

Continued on page 74

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New Products

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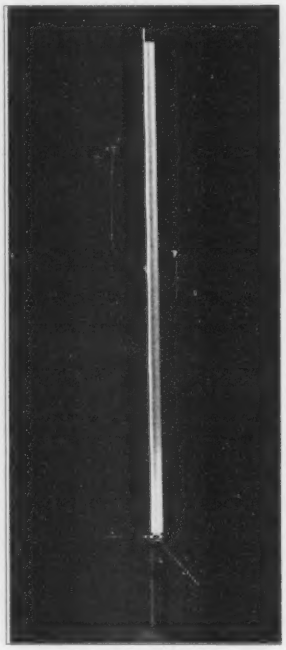
The Genesys G-1, from Genesys Products Group, provides 3 dB gain on 146 MHz and 6 dB on 446 MHz. It's 42" high, and has three ground-plane radials and an SO-239 UHF connector. It has a white fiberglass top and an aircraft aluminum base. It comes with U-brackets that will fit up to 2.5" masts. List price: $99.95. For more information, circle Reader Service No. 202.



The Genesys G-1,

A New Battery!

Bolder Technologies has come up with a new lead-acid battery design that looks like a real winner for applications requiring a lot of current and a short recharge time. They've made their cells much like a capacitor, using thin lead foil and an electrolyte instead of a dialectric material between the windings. Each cell is about 1" x 3" and provides about 2 volts. These are going to be very useful for power tools, uninterruptable power systems (UPS), portable equipment, electric scooters, and even cars. A battery weighing less than two pounds can start a car 20 times on a single charge! Being lead-acid, it doesn't have the memory problems of NiCd batteries.

One other factor is that there is a well established recycling industry for lead-acid batteries, and none for the far more toxic cadmium or lithium.For more information, circle Reader Service No. 204.

Manufacturers please send your products to be reviewed to Richard. Call 603-924-0058 for details.

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Dalco Data Protector

Above & Beyond

Continued from page 64

You would not want to pick up a laser head that was miswired. External power supplies providing the several thousands of volts needed for the operation of a laser head provide a ground to the negative portion of the power supply. I have found this wire to be somewhat small gauge and prefer to operate my systems with a much larger system ground that ties common with the power supply and laser head. A sturdy copper braid like coax shield has been successful. The braided shield provides a great deal of flexibility and a sturdy conductor. Whatever you use make sure your equipment is grounded and that the protective case ground is just that: *ground*. A new laser can be obtained but there is only "*one of you*." Safety First!

Laser Power Supplies

There are several different types of laser power supplies available. They range from units that can be operated from 110 AC to 12 volts DC input. For our applications the 12-volt DC supplies are the most desirable. These supplies make portable operation possible without DC-to-AC inverters and long power cords. Though it is possible to build a switching power supply using a single toroidal cup core transformer with a 12-volt primary, I found the winding process quite tedious. Think of it with 30 or so turns at 12 volts. How many turns does it require to obtain something near 1500 volts?

I tried constructing a 12-volt laser power supply using a large cup core transformer scrounged from surplus PC boards. The cup core was an inch and a half in diameter and one inch high. I wound the primary with 60 turns, center tapped, which filled one layer of the cup core. I insulated the cup core from the primary with Teflon™ tape used for plumbing applications. I overwrapped the primary winding to further insulate the primary and secondary with the same Teflon™ tape using several layers of tape. I then started to wind the secondary with #40-gauge insulated wire. I have to admit I lost count of the turns on the secondary several times as winding some 600 turns proved to be harder than I had thought.

Now the final scenario. After locating high-voltage rectifier diodes (not the 1,000-volt variety but 10,000 volts) and some capacitors rated at 3,000 volts, you can expect a good dent in your pocketbook. Why these high-voltage components? Well, this is part of the extra circuitry that needs to be applied to a laser power supply to provide something over 1,000 volts at a few mA. What is needed is a circuit added to the high-voltage path to provide a 10,000 or so peak starting voltage when the laser supply is first turned on, to ionize the gas in the laser head. After the laser is ionized the lower voltage will sustain the ignition and operation of the laser.

The ignition circuit is nothing more than a series voltage multiplier that boosts the 1 kV DC to about 10 kV for a very short interval only, when the laser is off and just before it ignites. When the laser ignites, this circuit self-disconnects electrically, allowing the low-voltage power supply to flow through this network. The circuit does not function as a multiplier, but rather like a series pass element. The multiplier will only function at microamp current

Continued on page 77

Hidden Antenna Kit

Just the thing for cliff dwellers and covenant-restricted hams. Check out the TapeTenna from Hamco, with 108 feet of half-inch wide copper foil tape, connectors, and an instruction book. The tape will stick to just about anything, indoors or out. You can even paint over it to make it more invisible. It's $34 ppd. That's cheaper than moving to a more ham friendly QTH. For more information, circle Reader Service No. 201.

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Communications
Continued from page 71

One interesting aspect of HDTV is that, although it is very different from NTSC, it has been purposely designed to be compatible with computer applications. The idea is that the same HDTV sets could also be computer monitors. Since the digital transmission method used for HDTV can accommodate digital data as well, there is an underlying hope that television and computers will merge into the ultimate tool for the "information superhighway" of the future.

Summary

Although this part has just been a limited introduction to television, it has covered several important concepts. Aside from an idea of how TV works in general, we have once again seen the impact of bandwidth on the transmission of information, and also once again seen the interaction between bandwidth and time. Although we haven't provided any definite proof (that would require some advanced math concepts), we still begin to see that bandwidth is a necessary part of communications. If a signal has no bandwidth, then it cannot transmit any information at all. 73

Hamsats
Continued from page 54

of 10 in the last 30 years, and the sophistication of the payloads has paralleled that of electronics advances over the same period. The equipment in the control room reflected the high level of technology required for flight control and monitoring.

Dwight showed the group a telemetry support package that straps onto a customer payload. The telemetry unit weighed a few hundred pounds and included the equivalent of a Pentium PC ruggedized for the rigors of high-altitude flight.

Getting a huge balloon and massive payload into the sky is a complex job. Winds must be below a few miles per hour and several vehicles are needed at the launch site. A minimal launch requires a helium truck, a spooler vehicle to deploy the balloon and lines, and "Tiny Tim." Tiny Tim, at the NSBF, is an electrically powered vehicle that holds the payload, and can be maneuvered under the balloon during launch so that the balloon, parachute, lines, and the multi-thousand-pound scientific package take off straight up. Just standing next to Tiny Tim gives a sense of how large the payloads can be. The wheels on the vehicle are nearly seven feet tall.

There were no launches at the time of the tour, but the public is welcome to watch from nearby roads when one does occur. Although most launches are scheduled for early morning hours or nighttime, variables such as weather conditions make it difficult to predict actual launch times. A typical launch may take two to three attempts due to conditions at the site.

One-hour tours are available by appointment and launch schedules can also be requested. If you are passing through east Texas, stop in Palestine. A visit to the NSBF is well worth the effort. The number to call for tours or information is (903) 729-0271. For other general information about Palestine, contact the Palestine Chamber of Commerce at (903) 729-6066. 73

***Photo E.** The payload launch vehicle is electric and big, with Mike WA5TWT (Ken Axelson photo).*

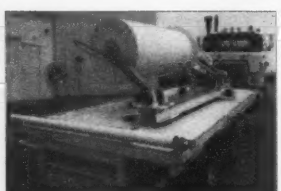

Photo F: The balloon spooling unit is required for proper balloon and line deployment during launch (Ken Axelson photo).

Never Say Die
Continued from page 4

and blinders of the establishment. Stock in the Big Bang has been dropping fast on the scientific stock market.

Okay, we have little balls of energy spinning, with the energy going around the outside of the ball and up into the center vortex and quickly coming out the bottom again. As we know from whirlpools, tornadoes, and plasmas, vortices suck. This force holds the ball of energy together. It also tends to attract any nearby energy balls, thus providing what we perceive as gravity.

"It's matter being made up of spinning energy fields which cause inertia."

In my editorials in *Cold Fusion* I've suggested a new model for the atom. I give full credit for the direction my thinking has gone to *Cold Fusion* scientific advisor M. Srinivasan of the Bhabha Atomic Laboratories in Bombay, who put me onto the book *Extra-Sensory Perception of Quarks* by Stephen Phillips. And that book drew, in a large part, on the work of Besant and Leadbeater, as reported in their book, *Occult Chemistry,* which was published in 1908. Almost a hundred years ago! Using meditation, they either were able to visualize atoms and their constituents or else they were two of the luckiest guessers in history.

The next resource for me was Eric Lerner's *The Big Bang Never Happened.* Putting the data from these two sources together helped explain for me how the coulomb barrier could be breached for the cold fusion reaction. Then, as I got to thinking more about it, this also explained inertia. I'd recently read Peter Graneau's *Newton Vs. Einstein,* which confirmed that not even Einstein was able to figure out why we have inertia.

Now, if you figure that electrons and protons are made up of smaller energy bundles which are shaped like fat spinning balls with a tight vortex in the middle, you'll get the idea. These are balls of energy, whatever that is. Now, if you spin a gyroscope you have to exert an outside force to move it, and then it will keep on moving until another force changes its motion. Just like inertia. Thus, it's "matter" being made up of spinning energy fields which causes inertia. If you have a box full of gyroscopes, all spinning on different axes, you'll cancel precession.

Physicists messing with atoms and quarks agree there's spin involved with everything. And antimatter just has a reverse spin. So when you mix the two you have all that energy suddenly released. Whamo!

Doesn't that all make sense? Now, what is this energy stuff that's spinning around?

Well, you can see why I'm having so much fun with all this. Sure, I'm probably wrong. History says so, for every atomic theory in the past has eventually been proven wrong as our ability to extend our senses with instruments has developed. And ditto our cosmological theories, no matter how fervently held. Ask Galileo.

I tried out my theories in *Cold Fusion* editorials, since they're read by many physicists. I've had some enthusiastic responses, and no negatives. That really surprised me. Well, I'm reading and learning as much as I can. How about you? Are you drinking beer and watching ball games or learning new things? I don't know of anything more fun than grasping new concepts. Well, maybe skiing like a bat out of hell down a mountain, carving those turns. Or working the only station in Iraq and having a chance to more than swap QSL information.

Speaking of Iraq, I hope I'll be able to find time to start putting together some slide shows on my computer so you can see what I saw on my visit to Iraq. I took some fabulous pictures and now I've got a J-Peg program to scrunch 'em onto a disk. The next step will be the development of a way I can send my pictures and stories over 20m. How about working on that for me? And writing it up as you progress?

Magnetic Power

There's what has given me the impression of a lunatic fringe lurking just outside the cold fusion field, probably attracted by visions of yet another source of free energy. Some of them are believers in the magical abilities of certain type of coils to generate an anti-gravity force. Others are firm believers in what they call zero-point energy. This has to do with being able to tap what they believe is an enormous amount of

Continued on page 76

How About a 2W 40m

Continued from page 51

inside the NorCal 40A to mount the keyer/counter and make the great little rig even better.

If the new builder ends up bungling the kit, he can send it back to Wilderness and get it fixed for a flat fee of $50 plus $5 shipping, provided it is repairable. Technical support is available Monday through Friday from 10 a.m. to 5 p.m. Pacific time. The kit currently sells for $129 and is well worth the money.

I made sure I really took my time building this kit. I have learned that it takes a lot less time to build it right the first time than it does to fix it later, and there is a lot less tension produced. The NorCal 40A has a small parts count, which made this kit very easy to build.

The printed circuit board was fantastic. The silk-screening was very clearly marked so there was no doubt in my mind where each part went on the board. It was also a pleasure to solder. The board seemed to just suck up the solder. You should use a sharp-pointed soldering iron of 20 to 45 watts. When you solder remember to keep the tip at an angle and heat the soldering pad on the board and the wire coming through. Allow the solder to flow freely for a second before removing the iron. This will make for much better soldering joints. I found that even though I was really taking my time, the kit went together very quickly.

Sneaky Toroid Trick

The only possible obstacle I can see for the new builder is winding the toroids. Oak Hills has gone to providing these pre-wound. I believe that anyone can easily wind their own toroids and get a real sense of accomplishment doing so. There are easy-to-follow directions provided in the manual. The VFO toroid requires a large number of turns. I cheated. I had my wife wind the VFO coil and she did a beautiful job.

One thing I really appreciated was the quality of the magnet wire provided. I find that it is easy to wind the toroids if you take your time, but that in many cases you can easily mess up when it comes to removing the insulation on the ends that get soldered to the board. If you get too rough they tend to break. The wire provided with this kit for winding the toroids has heat-melt insulation. When you are done winding you take a lighter and melt off the insulation at the ends, then take some sandpaper and make sure they are clean. You might want to check for continuity in the sets of wires with an ohmmeter before you solder them to the boards.

When you finish most kits there are a number of wires you need to hook up to connect various controls and jacks. Since this kit had all board-mounted controls and jacks, when I was done putting all the parts on the board, I was pretty much done building. It didn't take long to mount the printed circuit board to the bottom cabinet.

The Old Smoke Test

No matter how many kits I build, I always get nervous when applying the power. It can be a bit depressing to smell smoke. Make sure you have the polarity of your power source correct. The manual provides a chart for you to check voltages should you find there is a problem. If you smell smoke, turn it off!

The manual clearly tells you to set the trimmer capacitors and variable resistors to

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their initial positions. You next hook up a set of headphones that need to have a stereo headphone plug. You hook up an antenna and turn on the rig. I heard a hissing in the headphones; well, at least one part of the rig appeared to be working.

To align the receiver, you simply adjust two of the trim capacitors while listening for a signal. The adjustment is fairly sharp. When you get it right it is obvious because the signal you will hear will be a lot louder at this point. You will next need to adjust the VFO to the correct frequency. I have a frequency counter and used it, but you can do the alignment with a transceiver, preferably one with a digital readout. The rig came up close to frequency and it only took me a minute to adjust the frequency to where I wanted it. If you don't modify the rig you should be able to adjust it for any 40 kHz of the 40 meter band.

The rest of the kit was a breeze to align. You adjust a trim capacitor for the BFO pitch and set the AGC control, if you want to use it. To adjust the transmitter you adjust one variable resistor for power output. Make sure you use a dummy load or at least have an antenna hooked to the rig when keying it. I use a QRP wattmeter to adjust the power. If you don't own one you can simply adjust the control as described in the manual. A couple more simple adjustments and you are done.

Hey! It Really Works!

I hooked up the power, a small amplified speaker (I don't like headphones), the antenna and a key. I tuned around and found signals popping out clearly. The receiver seemed to hear well and was quiet. I tuned around and heard KFØN calling CQ. I gave him a call and he immediately came back to me. Larry was located in Cedar Rapids, IA. I was using less than 2 watts to a ground-mounted vertical antenna. After exchanging signal reports, names, and QTHs, he said "FB, wow! Your 2 watts doing a splendid job up here." We ended up talking for over half an hour. I noticed that the VFO on my rig was stable, so I didn't have to mess with the controls during the QSO. It turned out that Larry was on a Heathkit HW9 running 4 watts. I took this as a sign from above. My favorite QSOs now are QRP-to-QRP. We spend our time talking about QRP and various kits. It is hard to explain in words how much fun that first contact was and how loud my yell was when I first heard him come back to me.

After finishing with Larry, I worked Rich WB2VPH in Brockport, NY. I next worked Steve NØJGU/M near St. Louis, MO, and then many more contacts, one after the other. I was able to hear many stations and work all the ones I heard. I got consistently good reports on how my rig sounded and how well my signal was getting out. Who can ask for more than that?

Increasing the Tuning Range

Modifications that you can add are listed at the end of the manual. The one I did was to replace the 47 pF NPO capacitor in the VFO circuit with a 56 pF NPO. This gave me 60 kHz of coverage from 7.000-7.060, which is all I use of the band. This modification causes the RIT to have a greater range. You can simply change the value of this capacitor while building the kit. Make sure you use an NPO capacitor to maintain the stability of the VFO. There is plenty of room in the cabinet to put in a 10-turn pot which will increase the VFO range up to 150 kHz to get the full CW band coverage.

The bottom line is that this is one great kit. It was a lot of fun to build and it really works. The receiver is both sensitive and selective. My rig has a very stable VFO so that I stay on a given frequency. The 1.8 watts seems to be enough for me to work most everything I hear. The rig is very small and can run for quite a while with a small gel cell. This makes it an excellent backpacking rig. I find one of my greatest enjoyments in ham radio is talking to other hams using battery power on a little transceiver that I built myself. 73

The Details

DC Power Requirements: 10 to 16 VDC; reverse-polarity protection

Receive: 15 mA

Transmit: 225 mA at 2.0 watts output

Frequency Coverage: VFO operating frequency: 2.085 MHz nominal

Covers any 40 to 45 kHz segment of the 40m CW band (7.0-7.15 MHz)

Drift: 100 Hz total from cold start at 65 degrees F

Transmitter: Output: 0 to 2 W, adjustable

Final amplifier efficiency: 70-80

Load tolerance: Brief operation into high SWR

Transmit offset: 400-800 Hz, adjustable

Transmit-receive delay: 200 milliseconds

Receiver: Sensitivity: Better than 0.5 uV for 10 dB S+N/N

Selectivity: 400 Hz @ -6 dB, 1.5 kHz @ -30 dB

IF: 4.915 MHz, 4-pole Cohn crystal filter

RIT Range: +/- 2 kHz at center of VFO tuning range

Audio output impedance: 8 ohm or higher (head phones or speaker)

You can join the Northern California QRP Club-NorCal for $10/year US. This includes a subscription to *QRPp*, which is published four times a year. Write to: Jim Cates WA6GER, 3241 Eastwood Rd., Sacramento, CA 95821. You must be a member to purchase their projects.

NEVER SAY DIE

Continued from page 74

energy that exists in the "ether," a.k.a., space. Not being able to grasp the concepts involved, I've been awaiting something more substantial than the emotional writings of the True Believers to convince me, thus irritating the hell out of them. But then I've never been swayed by the emotional attacks from True Believers, whether they be proselytizing or defending a religion, the ARRL, CW, or some imagined potential ecological disaster.

If these so-called "N-machines," which are powered by magnets, are so great, let's see one working, was my approach. A reader from California called to say that he had followed up every reported working N-machine in the world and had yet to find one that would work when he was watching.

Thus, when I recently got a press release about a coming demonstration by Yasunori Takahashi of a working N-machine in Switzerland I faxed the London source of the release, asking for more information. I remembered getting a story several months ago about a Takahashi magnetic motor and its use in a scooter, so this seemed worth looking into. A return fax said the Swiss demo had been canceled. Hmm.

A few days before Thanksgiving Sherry said why don't we zip over to London for the weekend? We'd done this several times in the past, flying over on Wednesday evening and back on Sunday, thus not missing even a day's work. Several airlines have amazingly low cost package tours…if you call around $600 for the round trip, including ground transportation, hotel, and a London show, low cost. That's about what it would cost to stay in a New York hotel for three days, and never mind the meals. So I set up a meeting with the London Takahashi representative for Friday.

"Perpetual motion seems to be here. This is obviously impossible."

We'd gone via TWA in the past, but this time we tried British Air. Never again. Oh, the trip over was all okay, but they got us to the Royal National hotel by around 9 a.m. Thursday and the crummy hotel wouldn't give us a room until after 2 p.m. Not having been able to get much sleep in the cramped plane seats, we were in lousy shape to sight-see London. We wanted to sleep!

We took the underground downtown to see some tourist attractions for which we'd been given free tickets. When we got to the Tower of London, it was closed. Ditto the Banqueting House. We did see a few minutes of the Queen's Horse Guards on parade, and then we

walked a couple of miles back to the hotel, checking on what shows were running as we passed the theaters. None of the shows looked very good so we tossed a mental coin, which came up tails, and traded in our coupons for tickets to "Funny Money." When we got back to the hotel we sat. And sat. At two we got our room and crashed, leaving a call so we wouldn't miss the play.

The play was surprisingly terrible. I've seen far better on some silly British shows on PBS. But it wasn't much worse than the show we caught when we stopped by London on our way to Paris and Monaco for the March cold fusion conference. It was a comedy. I almost laughed a couple of times.

The next morning we went down to the hotel's $18 English breakfast which was included free with the tour. Major bummer. The oatmeal was cold. The poached eggs like rocks. The toast cold. The bangers yuuck. The stewed prunes hadn't been stewed. The OJ had a slight orange flavor.

We've done this London Thanksgiving tour thing many times, and TWA has always put us in top-notch hotels with superb food. Thanks BA for finding this hellhole for us. Everything about the hotel was cheap and shoddy.

After we recovered from the breakfast we took the underground to the suburbs and were met at the station by Takeo Sawai, who drove us to his home. There I was introduced to the Takahashi scooter. It had a small battery, used to get it started. Once running, the electric motor-generator takes over and runs the scooter, as well as recharging the battery. Yep, the motor runs a generator which then completely ignores the laws of physics by generating enough current to run the scooter and recharge the battery. Perpetual motion seems to be here.

This is, obviously, impossible. And the fact that the scooter could carry two heavy men uphill at a very brisk speed meant that some clever magic was being used. I put on a helmet, climbed on, and zoomed away, dodging oncoming traffic, as I sped around the London streets. Hey, this thing sure has a lot of pickup. It seems to have more power than my Yamaha scooter, which is no slouch.

The secret is in the magnets built into the motor. These are no ordinary magnets. I brought a few home to astound people with their power. I let one get within a foot of my underground ticket and it erased the magnetic stripe so the ticket wouldn't work any more.

The Background

Mr. Takahashi has some impressive credentials. He worked for Sony for several years and was involved with the development of their Trinitron, the Betamax, and the Walkman. This is not a hoaxer. Further, in addition to inventing the super-powered magnets used in his motor, he's also invented a capacitor dielectric that is unbelievable. Well, it would be except I have a copy of the patent.

The magnet came from Takahashi's work in developing high density magnetic material for videotapes. It's made of needle-shaped micro-magnets of yttrium, iron, manganese, X, which are glass-bonded. It has a coercive force of about 15 times that of alnico.

In reading the capacitor patents I found that Takahashi has developed capacitors which are 1/20th by 1/10th of an inch and have 250 µF capacity! That works out to about one Farad for an inch-square capacitor! Who needs batteries when we have such small sized capacitance available?

I hope one of these days to be able to get together with Takahashi and a good interpreter, so I can learn more about his dielectric, his magnets, and his motor-generator. I've seen it. I believe it. But I sure don't understand how it is possible.

Late news: The magnet motor has been issued a US patent (#5,436,518). In the accepted patent claims the input power to run the motor was 19.55 watts and the output of the generator was 62.16 watts. That's 318% output over input. So, though the system is obviously impossible, it not only works, but it's been patented. And I've ridden an electric scooter powered by the magnet motor-generator.

Stonehenge

On Saturday we skipped the free $18 English breakfast and went on a tour to Stonehenge. Sherry's been wanting to see the place. It was an all-l-l-day bus trip, which included stops at Bath and Salisbury. Our tour guide talked almost incessantly over the bus's PA system, giving us in a strident Julia Child's voice details of unmemorable significance on places we were passing as we drove clear across the country. We saw the rocks. No, I didn't get any feelings, other than some leg cramps and a tired bottom from sitting for hours on the bus. Don't miss Stonehenge if you go to England.

In Salisbury we visited a church where they have an original copy (is that self-contradicting?) of the Magna Carta. The Magna Carta room closed at 3 p.m....we got there at 5. Fortunately there was a symphony orchestra there practicing, so I got to show off my music recognition skills by identifying Richard Strauss's "Tod und Verklarung" for the other members of the tour group. Don't mess with me when it comes to classical music, okay?

The Fan Gets Hit

Sunday we returned home to New Hampshire. The BA meal was inedible. Sherry saved hers for the cat. I stopped by the office on the way home to pick up Friday's mail. Holy Jehosephat, there was a whole post office basket full!

On the Saturday morning before the trip I'd been interviewed for three hours by Art Bell W6OBB, who has a nightly talk radio show. I was on from 4 a.m. until 7, talking about amateur radio and other things.

I'd offered to send a 12-page booklet listing 49 books that people are crazy if they don't read to anyone requesting it. I also offered the 16-page instruction booklet on the blood purifier and a 32-page booklet of editorials I've written for *73*, but haven't had the space to run yet. I figured I'd maybe get a couple dozen requests.

Well I figured wrong. I began to suspect that when my fax machine started running through rolls of paper like a Broadway ticker-tape parade within minutes of the end of the program. Two weeks later it was still grinding out responses to the program. My 800-number at the office was lit up for a week. And then the mail started. It was only a dribble on the Wednesday I left for England. On Friday there were 257 letters.

I spent the rest of Sunday after getting back answering the requests with information on amateur radio, cold fusion, the book list, editorial packages, and blood purifier circuits.

The Monday mail was even worse. Whew! It tapered off a little on Tuesday and was down to only 60 letters by Wednesday. Helen, at the office, worked flat out making photo copies of the booklets, trying to keep up with the demands. By Friday I got 'em all answered.

By then the second wave had started to arrive. These were the orders for booklets resulting from my answers to the first requests. Subscriptions to *73* and sample copies of *Cold Fusion*. Orders for my submarine adventures in WWII book. Lots of orders for my *Declare War* book.

If I can get on a few more talk shows maybe we could get amateur radio growing again. But how about you? How about you leaning on any friends you have with talk shows to talk up our hobby. Explain how there is no such thing as a lonely ham. You turn on that switch and the whole world is yours. You turn it off and you're back alone again until you need company. Most of my friends down through the years have been hams I met on the air. Johnny Williams W2BFD, the guy who made RTTY happen. Sam Harris W8UKS/W1FZJ/W1BU, who pioneered moonbounce. Bill Hoisington W2BAV/K1CLL, who built circles around everyone else in the hobby for years. Chuck Martin WA1KPS/KI1O, who skied with me and went on diving trips for years.

Kids may not appreciate the entry into high-tech careers that amateur radio provides, but maybe their parents, who see the way the world is going, may encourage them. Ham radio did it to me and I don't regret one minute of it.

Amateur radio has provided me with a lifetime of adventure and unlimited career opportunities. Ham radio got me my first job as a technician at GE, testing the BC-191 and BC-375 command transmitters, back

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Above & Beyond

Continued from page 72

levels. When high sustained laser current (ignition) is running, the multiplier becomes bypassed series diodes, creating a very small voltage drop.

Well that's it for this month. Next month I plan to cover the laser power supplies and other components.

73 Chuck WB6IGP

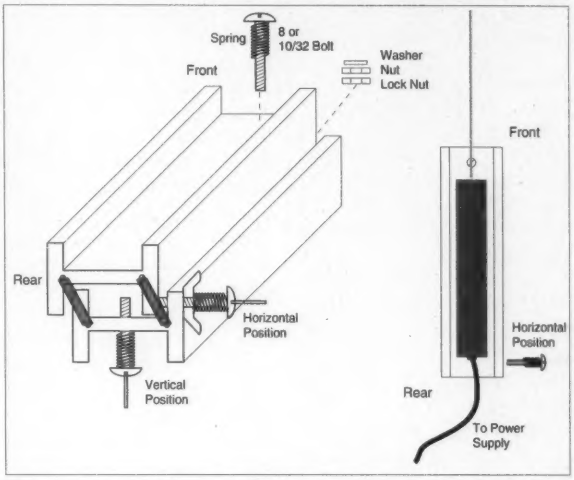

Fig. 3. *Complete drawing of the laser carpenter level mount.*

Ask Kaboom

Your Tech Answer Man

Michael J. Geier KB1UM
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70 Route 202 North
Peterborough NH 03458

Monitors

If you've been to any hamfests in the last five years, you undoubtedly have noticed that they tend to be filled with more computer gear than radio equipment! I suspect most hams are computerniks, and the two do go together rather well. Although I see lots of PC clones and even a few Macs, the one thing I see more of than anything else is monitors. There are all kinds of monitors at bargain prices, including monochrome, CGA, VGA and SVGA. Some have coarse dot pitches, which may be the reason the seller is getting rid of them. Others may have nice, .28-mm dots, making them excellent choices for today's high-resolution computer displays. How can you discern the dot pitch? It takes a little practice to get good at judging them, but there are two ways to tell: First, look at the monitor's model number. Usually, the last numbers in it give the dot pitch. So, an SV 29N has a .29-mm dot pitch, which is pretty good. A VL-4539, though, would have a .39-mm dot pitch, which is pretty ugly. If there's nothing obvious from the model number, take a good look at the screen. With a working monitor, it should be quite clear whether the image is made of fine dots or not. If the set is dead, though, you can still get an idea by shining some light on the screen and looking closely. If you see an obvious, square, blocky pattern, chances are the unit has an unacceptable dot pitch. If, though, you see tiny dots, and especially if they're not easy to make out, you've probably got a good, fine pitch and will be happy with the monitor. That is, if you can fix it!

Alphabet Soup

VGA? CGA? EGA? SVGA? RGB? Hercules? Multisync? Unlike with regular TV sets, there are lots of different signal standards for computer monitors, and the one you buy must match your computer's signal or you're out of luck. What do you need? Most PC clones today use VGA and/or SVGA. If you have an old XT, it may need CGA. Take a look at the video connector. If it's a nine-pin, it's probably CGA, although it could be Hercules. If it's a high-density 15-pin, chances are it's VGA/SVGA. Naturally, be sure the plug on the monitor you're looking at matches the one on your computer!

If you're a Mac user, you have several options. although Macs are made for use with Apple monitors, which have a different scan rate from the IBM standard, many multisync monitors will work, as long as you procure or make the required plug adapter. Even better, many newer Macs can use regular, non-multisync VGA and SVGA monitors! All it takes is a plug adapter cable wired with a specific connection that tells the Mac it's connected to a VGA monitor. From my experience, even many Apple dealers don't know that. Not all Macs can do it, though, so check the manual for yours before investing in a VGA monitor. If it will work, you can save quite a bit of money, because VGA monitors cost a great deal less and are much more easily found on the surplus market.

Pick One

If you want to pay $100 to $150, you can get a monitor that works fine. Even in that price range, though, take a good look at the picture before you buy; some of those sets have been on for thousands of hours and have weak CRTs, and others have crummy dot pitches. What you see is what you will have to live with, so choose carefully, remembering that you can have a new monitor with a .28-mm dot pitch for about $225 to $250 if you're a careful shopper. In general, avoid old looking, dirty, beaten-up units, as you would with anything else. If it looks like it's spent its life in a dirty warehouse, it probably has, and you would best avoid it.

R.I.P.?

How dead is dead? If you want a monitor for $10, don't expect it to work at all. Probably, the power light won't even come on. Often, the seller will tell you that he doesn't know if it works, or that it worked the last time he tried it, but it's been awhile. Take that as hamfest code for "it's dead!" Surprisingly, there seem to be lots and lots of dead monitors out there! So, let's take a look at what you can expect to find, and how best to go about fixing those cheap, dead monitors.

Just a TV

Really, a computer monitor is nothing more than a TV set. There are a few differences, however. First, there's no tuner. Second, all that NTSC color decoding circuitry is gone—modern computers send their red, blue and green signals on separate wires. Third, there usually is no sound circuitry. So what's left?

Just the nasty stuff! A typical computer monitor consists of a power supply, horizontal and vertical scanning circuits, a high-voltage supply for the CRT, video output amplifiers (one for each of the three colors) and, of course, the CRT assembly itself, with the yoke and convergence magnets. Generally, the convergence, which is what keeps the three colors aligned with each other on the screen, is static. That is, it is accomplished by nothing more than a group of magnets around the neck of the tube. If it's a really big monitor, say 17 inches or more in screen size, it could have dynamic convergence, which is done with a bunch of circuits that generate some extra currents which are used to adjust the convergence as the beam sweeps across the screen.

Most television problems occur in the power supply, scanning and high voltage sections, so the lack of all those other circuits doesn't help us much here. Most of the dead monitors I've bought have had either blown power supplies, blown horizontal output transistors, or both. Assuming your monitor exhibits no signs of life at all, it's best to start with the horizontal issue.

But First

Before we do, though, I must warn you about something: The insides of TV sets are extremely dangerous! A typical color CRT requires about 30,000 volts at its anode (yes, you read that right!), and other voltages ranging into the thousands at other terminals. There's plenty of current, too, so you can be killed if you're not careful. Also, the picture tube itself is fragile enough that you can break it with a dropped tool, and its high internal vacuum can make it implode like a bomb, causing just as much personal injury as an explosive device. Be *careful!* Always shut the power off and pull the AC plug before disconnecting or replacing anything, and try to avoid disconnecting the anode lead from the picture tube. If you absolutely must do that, remember that the tube is basically a big capacitor which can store enough high voltage to finish you off. Discharge it by connecting a clip lead to the set's chassis and then connecting the other end to a screwdriver with an insulated handle. Now, touch the tip of the screwdriver to the inside of the dimple where the anode clip was, and hold it there for about 10 seconds.

Pop Goes the Output

Nothing in any TV set works as hard as the horizontal output transistor, so nothing blows out as often, either. This is a special, high-voltage, high-current transistor which generates not only the horizontal scanning signal, but also the high-voltage supply for the anode of the CRT. In some sets it generates many of the lower voltages as well. You'll find the part clamped or screwed to a big heat sink which is nearly always right next to the flyback. What's a flyback? That's just an old TV service shop name for the high-voltage transformer. It's easy to locate because its output lead is the thick one that goes to the side of the picture tube. Follow that lead back and you'll find the flyback and the horizontal output. Because they're multi-layered inside, horizontal outputs have a great deal of voltage drop and usually won't test properly on an ohmmeter or a garden-variety transistor tester, so don't bother to try. When I get a dead monitor,

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HOMING IN

Radio Direction Finding

Joe Moell P.E. KØOV
PO Box 2508
Fullerton CA 92633

New T-Hunting Goodies

"You never know where you'll end up and you never know what you will find." That's my standard answer when someone asks why I still enjoy hidden transmitter hunting after doing it regularly for almost 20 years. The outcome of a radio direction finding (RDF) contest (usually called a T-hunt or foxhunt) is seldom predictable. Hiders have an endless variety of places to put radio foxes, and they're always coming up with new ways to disguise them.

You may have to drive several dozen miles in the right direction to get to the hidden T site, but that doesn't mean it will be in plain sight when you arrive. Sometimes the greatest challenge comes when your car reaches the end of the road and you have to finish on foot. You need good RDF gear for this part of the hunt (sometimes called the "sniff"), because your eyes can be deceived.

On one of my first transmitter hunts, the signal led me to a street of new homes in Phillips Ranch, California. Each had a very large front yard with a rural mailbox at the curb. The hider and his distinctive jeep were nowhere to be seen and no radio gear or antennas were visible. Several T-hunters were wandering around, finding nothing out of the ordinary.

RDFers who performed careful close-in triangulation while rolling their cars slowly down the street soon discovered that the signal was very strong in the vicinity of one mailbox. Upon closer inspection, they realized that the name on the box was "T. Hunter" and the transmitter was inside! Hider Rich Krier N6MJ had put a handie-talkie, battery pack, and tone box into a standard rural mailbox, then painted and placed it to look like all the others. He had drilled a hole from the box interior into the 4" x4" wooden mounting post and lowered the antenna into it. The whip was perfectly concealed, yet it put out a good signal.

***Photo A.** The Agrelo Engineering HPVFC micro-transmitter is factory-tuned into a 50-ohm load with the trimmer capacitors on this side of the board. On the other side are 46 SMT components.*

Since then I have enjoyed the fun of hiding tiny transmitters in unexpected places and watching T-hunters try to find them. This kind of T-hunt is popular all over, as evidenced by a recent Internet posting by Bruce Paterson VK3TJN. It told of a November 1995 hunt near Melbourne, Australia, that was put on by VK3VR, VK3MZ and VK3TVB, the current Australian champions.

VK3TJN wrote, "Any observers watching the conclusion of the next event would have seen a number of hounds madly rummaging around in shredded wood surrounding a climbing frame in a playground. Those with keen eyes would have noticed that a nearby wooden log had a hairline crack around it, as it had been hollowed out to fit a small transmitter inside. Four teams had managed to recognize this and then check in, before the cry of 'It's in the log!' from one jubilant hound shattered the silence."

Move Over, 007

Today's Surface Mount Technology (SMT) has made it possible to shrink a fox transmitter to the size of a pack of gum. The N6MJ mailbox trick could now be done with the entire transmitter inside the post. Hunters opening the mailbox door would see nothing at all!

"Homing In" for May 1993 featured construction plans for the smallest 2 meter FM transmitter board I've seen, designed by Ken Bauer KB6TTS. Small enough for two to fit side-by-side on an Elvis stamp, it puts out about 25 milliwatts with a 9-volt supply. I keep this transmitter, plus a tiny CW ID unit (reviewed in "Homing In" for August 1993) and a 9-volt transistor radio battery, in a small pill bottle. It goes with me whenever I talk to a ham club about T-hunting. Usually somebody hides it nearby and everyone gets a chance to try on-foot foxhunting with their handie-talkies and the "body shield" technique.

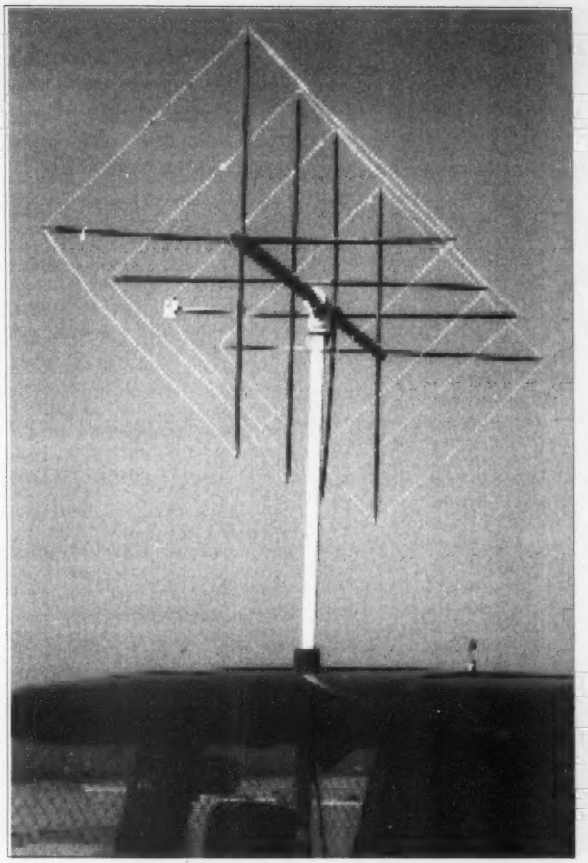

***Photo B.** The Cubex Yellowjacket four-element 2 meter cubical quad received a thorough test on my T-hunting van.*

This tiny T has been one of the most popular "Homing In" projects to date. One ham who was especially impressed by it is Joe Agrelo N2OOC. He is the owner of Agrelo Engineering, a company that specializes in electronic design and manufacturing. "Mainly we do custom designs involving our digital voice recorder boards for clients around the world," he told me. "Our advertised products extend from my personal interest in amateur radio and a fascination with RDF."

Joe decided that a micro-T would be a good product to start his line of RDF gear. He realized that 25 milliwatts is fine for short range or high elevations, but most T-hunt scenarios demand more. "We built a few of the tiny Ts and had lots of fun, but they lacked the power we were looking for," he says. "Ken Bauer seemed to be a good choice to design a higher-power T for us and he agreed to do it."

By the time solder fumes cleared in the Agrelo lab, two models were ready to sell. Both are crystal-controlled with true FM modulation of the oscillator stage. Each includes an electret condenser microphone and high gain audio amplifier. There is a high-level (1 to 2 volts peak-to-peak) audio input also, to mate with your favorite "foxbox" tone generator.

At 1-1/2" x 9/16", the model VFC400 is only slightly larger than the 1993 "Homing In" project. With a 6-VDC supply, the unit I tested put out 190 milliwatts while drawing 140 milliamps. Four AA cells will power it for 20 transmitting hours. At the end of that time, the batteries will have sagged down to about half voltage, giving only 80 milliwatts output.

All hams seem to have inherited the "more power" gene, so it was natural for N2OOC and KB6TTS to

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NEVER SAY DIE
Continued from page 77

in 1942. Ham radio got me into the Navy as a Radio Tech, and then as an Electronics Technician. And that got me plenty of adventure on a submarine during five war patrols. After college it got me my first job with radio station WEEB in North Carolina. Fellow RTTYers got me jobs later as the Secretary of the Music Research Foundation (where my classical music background helped), and working on a color organ Guggenheim Grant project for the Guggenheim Museum on Fifth Avenue.

It got me my first job in publishing as the editor of *CQ*. Most old-time hams have similar stories to tell.

So let's get out there and talk up our hobby and get the kids to think in terms of getting a ham ticket instead of the dead end of CB.

If you can't handle a talk show interview, at least see if you can get me connected. I can talk for hours. And hours. Did I tell you about the time I talked two hams into going on an African hunting safari with me? Robbie 5Z4ERR talked me into it on 20m. Wow, what an adventure that was!

If you've had some exciting ham adventures, why not grab your word processor and write? If I don't have enough room in *73* for all the stories I might make 'em into a book we can send to prospective hams to get their juices going.

"When you're running a ham club you are in show business."

How about the time I got 73 hams to go with me on a tour of Europe, with hamfests in London, Paris, Geneva, Rome and Berlin? Boy, did we have fun! We still talk about it when, at hamfests, I meet the hams who were on the trip with me.

And if you can't get on a talk show, at least get around to your local schools and talk to the fifth- and sixth-graders and get them excited.

Ham Club Woes

Between the ultra-bad band conditions of the last couple years, mainly the result of our not spending more for sunspots, and the continuing drop in the number of active hams, I'm seeing more and more anguished articles in club newsletters, hand-wringing over the club's disintegration. There are the usual complaints of no volunteers to help, fewer members coming to meetings, and so on.

My message is simple: Stop your bitching and breathe some life into your club. One fact of life is that very few club members ever have or will volunteer to do anything…unless you get them excited and involved. Most clubs are kept together by one to three spark plugs. It really only takes one to make a big difference.

Let me ask a direct question. How exciting are your club meetings? I've been to far too many clubs where the meetings are deadly bores. Where the president doesn't know any better than to allow business discussions to waste meeting time. If someone in the club has an unstoppable need to have business meetings, at least have them handled by a small "executive committee" and keep club business out of the regular club meetings. All you need is a short report from the executive committee on their actions.

I remember when the Nashua (NH) club spent an entire Friday evening discussing what color to paint the club building. That one bomb discouraged at least 10% of the members from coming again. It wasn't long before the club had no further need for their building and had to give it back to the city.

When you're running a ham club you are in show business. Meetings have to be fun or you'll lose your audience. Every meeting has to provide enough benefits to every member to get them to come back again. Otherwise you're up against Strange Luck, the X-Files or a movie. You have stiff competition, so you'd better put on a good show.

Benefits?

When's the last time you had a club member put on a slow-scan show and tell? Satellite communications? Packet? RTTY? Have you been giving your DXers an opportunity to show off their latest hot QSL cards? Certificate hunters their trophies? Have you invited a nearby ham dealer to tell you about some of the crazy things he's run into doing business with hams? Are there any ham manufacturers within driving distance?

You need interesting speakers. If you can't get them directly, maybe you can get them to do a video talk-to show to the club.

Speakers?

Here's the rules for speakers. If they're coming in from any distance you should offer to pay their transportation costs. Get three or four club members together for a dinner before the meeting. If your speaker has to fly in, meet him at the airport. Drive him to the hotel where you've reserved a room for him.

Whether the speaker is local or imported, make sure that he is the big deal at the meeting. I've given talks to scores of clubs and more than I like to remember had endless business meetings before it was time for me to talk. By then most of the members were just about asleep. Thanks, fellas.

If you're going to have elections, for heaven's sakes don't have a speaker that night too. That's happened to me at least a couple dozen times. Along about 10 p.m. I'm given the floor. By then I need a cherry bomb to wake 'em up.

The speaker comes before the coffee and doughnuts, too. Coffee is supposed to be a stimulant, but in my experience the only thing it stimulates at meetings is sleep.

If you find any outstanding speakers please drop me a note so I can pass the word along for other clubs. Alas, we don't have nearly enough good showmen among our manufacturers.

How About Me?

Probably not.

When I signed on as the editor of *CQ*, back in 1955, I was asked to speak at some hamfests. Whooee, did I have stage fright! When I got up to talk, my mind would go blank. A few hundred talks later I really enjoy giving talks and I almost never plan ahead. I just wing it, and generally keep everyone laughing. Well, look at all the really stupid things that we hams take seriously. Like the Honor Roll, the "need" to work a new DX station, the pompous foolishness Glenn Baxter airs endlessly, the garbage on 14,313, repeater jamming, the importance of the CW test to weed out the CBers, and so on.

The best ham raconteur by a wide margin is Jean Shepherd K2ORS/4,

"Our eating and drug habits are generating a wonderful $1 trillion business."

if you can coax him away from Florida. Try dangling $1,000 and trip expenses and see if that'll break him loose. He's worth every penny. All you have to do is get around 300 hams to pony up $10 each and then promote the heck out of the event.

These days I don't have much time available to address hamfests or clubs. If I did have the time I'd like to get on the air more, and maybe visit a few more countries. There's still a bunch I haven't visited yet. But I've thinned down the *73* staff and am doing a lot more of the editing myself, which really eats up the time. Well, I wasn't happy with the way the magazine was going, so I decided to clean house a bit and run things myself for a while. I hope you'll begin to see some improvements. All this while the cold fusion field is really heating up. I've even had to turn down a speaking request in Russia. But just keeping up with the profusion of papers being generated in the cold fusion field is a serious time user.

Anyway, let me know what speakers you've had at your clubs that you recommend so I can pass on the word.

Tech Sessions

How about providing a half hour or so of theory before the regular meeting? There are few club members, young or old, who wouldn't benefit from this. Heck, you might even set up some code practice sessions before the regular meeting…one at 13 per and the other at 20 per. Teach 'em using my system. You can even talk to the group while they are copying, thus making sure they are copying automatically, and not trying to translate the dots and dashes.

Your Mercedes

If you've followed ol' Uncle Wayne's advice and started your own business, one of these days you'll be thinking of buying a Mercedes, Jaguar or Porsche. The Mercedes is a good investment because it's so well designed and built. The darned things often last for half a million miles, if you treat 'em right.

That means not using old crankcase oil for the engine, or tap water to refill the battery. It means not putting iron filings or sugar in the gas tank. It means cleaning and polishing it now and then. If you've ever seen a concours d' elegance contest, you've seen 20- and 30-year-old cars that look showroom-new.

Why should I make such ridiculous suggestions? You'd never treat a $50,000 or so car that way, right? So why would you care more about your car than your body, which is infinitely more complex and valuable to you? If you make enough money you can always replace even the most expensive of cars. But you get only one chance with your body. If you screw it up, there's no replacement, no matter how much money you make. Think about it. If you care to look at the instruction book for your body you will find big bold warnings against fueling it with Big Macs, fries and Coke. Worse, you not only are putting metal filings in your fuel system, you're encouraging your children and grandchildren to prematurely destroy their bodies too.

If you think I'm exaggerating, just take the time to go to a hamfest and take a good look around! These guys are busy reducing the expected life of their bodies from a vigorous 100 years to a sickly 50 or 60.

No, don't turn to your doctor for the instruction book. Up until a few years ago most doctors smoked, showing how little attention they've paid to the maintenance of their own bodies. Cigarettes were called "coffin nails" back in WWI, so there's never been any real secret about their destroying the body.

How many people in their 60s or 70s do you know who are in robust health? Well, the bright side of all this is that we're keeping the doctors and hospitals busy. Our eating and drug habits have generated a wonderful $1 trillion business and some

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"Fluoridation is doing everyone exposed to it serious harm."

frosted garbage for breakfast. Boo Berries?

There goes Wayne again? Hey, I've given you the references on all the above so you can do your homework. Please don't take my word for any of this. Do your own reading. I've read hundreds upon hundreds of books, and I've reviewed those for you that I've found the most authoritative. If you haven't kept track of my reviews, I've put them together in a booklet describing the books I think you are crazy if you don't read, together with the sources, if they are not likely to be available from your local library. No, I don't sell them through Uncle Wayne's Bookshelf. Oh, I considered it, but then I'd be accused of trying to make money with my recommendations. No, you're going to have to get these books on your own.

I mentioned my list during a recent radio talk show interview and got over a thousand requests for it. Then came the follow-up letters thanking me for doing all that research, and telling me how wonderful the books are I've recommended. You can have my list for $3 plus a 6x9 envelope with a 32¢ stamp on it. If you don't have an envelope, then make it $4 and I'll address it to you and put on the postage. Send cash or check to Uncle Wayne, 70 N202, Peterborough NH 03458-1107. If you order at least $10 worth of stuff you can use a credit card, and even call in your order. Like a subscription to *73*, for instance, or a couple more of my booklets, or even my *Declare War* book.

If you ruin your Mercedes you can always buy a new one. If you ruin your body, you'll have to reincarnate to get a new one. Think about that the next time you buy a six-pack.

Death By Government

The more I read about the things our government is doing to us, the more discouraged I get. Not just that it's happening, but that we, the people, let it happen in the first place, and then, even after we find out about what's happened, we don't made any serious effort to stop it. I've written about how our government is allowing our dentists to continue to put dental amalgam in our mouths, and our children's, even though it's 50% mercury, which is acknowledged to be a deadly poison, which is causing terrible health problems for millions of people. I've written about vaccinations and the trail of death and sickness they're leaving, with there not being one shred of scientific proof that they work.

When I was a lot younger I remember the fight a few extremists put up against our city governments fluoridating our water. Bunch of kooks, we were told by the media. Well, I know you're not going to believe this, but it turns out the kooks were right, for a change. There are any number of scientific studies which show that (a) fluoridating us does not help fight tooth decay, and (b) the fluoridation is doing everyone exposed to it serious harm.

Sure, only a small percentage of the children who get their teeth swabbed with a fluoride solution by dentists or their dental assistants die from it. I suppose that's an acceptable loss, as long as it isn't your child. And it's not enough so the doctors can't cover it up to avoid lawsuits.

In areas where the water has been fluoridated the cancer rate has increased substantially. In high fluoride areas the people age prematurely, their teeth drop out, and their bones get very brittle. Even minor shocks can cause a hip fracture, which in an elderly person is virtually a death sentence.

How about the three-year-old child who had his teeth swabbed at a clinic? The nurse gave him a glass of water to rinse out his mouth and turned away to gossip with someone. The child drank the water and was dead in a few hours.

There goes Wayne with his hyperbole of gloom and doom, right? Hey, don't believe me. But do get a copy of *Fluoride, The Aging Factor,* by Dr. Yiamouyiannis, Health Action Press, ISBN 0-913571-03-2, 292p, $15, and do your own homework. He's got all the research data there for you. I'm not exaggerating, I'm understating the situation. Yes, your government is, in many cities, pouring this poison into your water supply. And this poison is not only causing a wide range of illnesses, it is also causing chromosomal damage which is then passed on to the next generation. Cities and towns are adding from 0.6 ppm to as high as 8.0 ppm of fluoride to your water.

How do you get away from it? A home still helps. I've been drinking distilled water for some time now, and am getting my own still. How about Coke? The stuff is packed with fluoride (2.56 ppm). So is Diet Coke (2.96 ppm, and it only takes 0.5 ppm to cause serious trouble). And it has aspartame, to further derail your body's ability to cope with life.

Freedom

For a country that prides itself on and preaches freedom, we have an awful lot of tyranny going on. I think I can even make a good case for liberals being disciples of the Devil. All those things that our beloved government legislates "for our own good" are my beef.

Like what? Like vaccinations, fluorides in our water supply, seat belt laws, helmet laws, and so on. I've written about vaccinations, which besides not working, are causing life-long health problems for many people. Ditto fluorides in our water. I wish that Congress and the state legislatures would stop using the law to do things for my good. All I need is the information and then the freedom to make my own decisions.

Sure, seat belts save lives, but if I'm dumb enough to not use them, then that should be *my* decision. Mother Nature (aka God) has a system that has worked for millions of years. Billions. It's called natural selection, or the survival of the fittest. So if I'm dumb enough to not wear a helmet on my scooter or a seat belt, if I get killed that will tend to weed out that kind of dumbness. By forcing me to live longer and thus be able to have more children, the government is going against God and weakening the human race.

How about so-called Social Security? It was originally set up as a way for the government to take in more money, pretending it was insurance instead of increased taxes. It's still taking in billions more than it's spending and Congress is "borrowing" the surplus and spending it. If it was a voluntary system I'd have no complaint. But it's mandatory, and that's not my idea of freedom. Sure, it's "for my own good." If I'm dumb enough not to provide for my old age, the government will support me. The result of that is that a lot of people don't provide for their old age in some other much cheaper way.

Water, Water, Everywhere!

And not a drop to drink. Well, not a drop that's safe to drink, anyway.

I've written about how we're slowly poisoning ourselves in various ways, all complete with references so you can completely disbelieve what I'm reporting and go to my sources. All I can do is lead you to the fountains of information, I can't force you to read. But at least, for those of you who have any interest in living long and in good health, I'm pointing out the path. Of course, if you prefer to smoke, eat crap, and couch-potato away your life, that's your choice.

Now, about water. My thanks to Emory Schley N4NCU, who dropped me a postcard suggesting I call Acres USA and get a copy of *The Choice Is Clear,* by Dr. Allen Banik. It's a 40p $2.50 book and worth a million bucks. Or whatever you feel your health is worth. Maybe 2¢ is closer, judging from the constipated 13-month pregnant potbellies I see walking around at hamfests. What a terrible thing to do to a perfectly good body! Heck, even when I was fat I never did *that* to myself.

Anyway, invective and insults aside, I got the book and loved it. I'd already read an excellent book on how the fluorides added to most public drinking water are causing serious illnesses. And I've seen references to the damage that the chlorine in our water is doing to us. But I thought that, heck, since I live on a farm with my own well, I was safe. Once I read the bad news in this book I sighed and started buying distilled water to drink.

You'll read about Dr. Bragg, who at 94 had the blood pressure of a 20-year-old. I seriously doubt you'll read this short book and not change to distilled water. The Dr. Banik book is available from Acres USA, Box 8800, Metairie LA 70011.

I've been lacing my distilled water with some of Pat Flannagan's Crystal Energy. But that's another story, and a fascinating one. I'll go into the details for you, complete with where you can get some of his magic elixir.

My water bill is mounting and I'm up to here in gallon water bottles, so I've got to shop around and see where I can get a still and make my own water.

The more research I do, the more I'm convinced that if we'd eat right, drink pure water, avoid EMFs, get rid of dental amalgam, avoid immunizations, and breathe clean air (such as we have in abundance in New Hampshire), we'd have a good shot at getting a mention by Willard Scott on the "Today Show." Of course, if you prefer that you and your family be crippled by arthritis, Parkinson's, cancer, diabetes, high blood pressure and so on, that's your choice. My dad chose to smoke despite anything I could say, so he had to spend the last 10 years of his life with an oxygen bottle at his side because he only had 5% of his lungs left working. Imagine not being able to really breathe for 10 years! He smoked Camels. Didn't the Marlboro Man die of cancer? Or was it emphysema? My grandfather, who smoked cigars, died in his 50s as a result. So did my uncle. And, unless the medical establishment puts out a contract on me for spoiling their business, I intend to keep writing my editorials for another 30 years. Or so. 73

Making Your Club More Exciting

How the BARA broke out of its rut.

Dee Interdonato NB2F
118 Westervelt Place
Lodi NJ 07644

Sometimes clubs stagnate with business meetings; the more active and creative members become discouraged, and stop attending meetings.

A few years ago, The Bergen Amateur Radio Association (BARA) was in just such a rut. We got to brainstorming as to how we might give our membership some fun, as well as show our local community commitment, *and* get some public exposure for amateur radio. With our 30th anniversary approaching, we wanted to cook up something special.

Since it was also the 300th anniversary of Hackensack and the 50th anniversary of the *Ling* submarine, where we'd successfully celebrated our 25th anniversary, we agreed on setting up another special events station on the *Ling*.

The plans for the special event kept us busy for the next few meetings, with excitement building among the club members. One member, Mike Surmick WA2QWM, was employed by the City of Hackensack (located in northeastern New Jersey), so he became our liaison with the city. In fact, he became the unofficial leader of our event and we used his call for the special events station.

Photo A. *L/R Vince N2AXV, John KC2EV, Mike WA2QWM, Dave N2IMC at the packet station.*

Photo B. *Dee Interdonato NB2F (the author) operating in the* Ling *radio room.*

We contacted the *Ling* and informed them of our intentions. After our 25th anniversary there, they knew us well and enjoyed the publicity as well as the added revenue from visitors. Now all that had to be done was planning for the special event station equipment and operators, the food, and as much publicity as we could generate.

The setup began in the morning and operation started that evening. Bob Wilson N2RLI volunteered his RV full of ham gear, and our Field Day antennas were ready to go. WA2QWM, our special event station on board the *Ling* was on the air!

After many hours of operation, hundreds of QSOs on HF, VHF, UHF, packet, and satellites, after numerous demonstrations and handouts about amateur radio were given to the public, after vast amounts of food were consumed, and the cleanup was over, the certificate committee went to work. Chaired by John Chooljian K2KRF (a WWII radioman on an LST in the Pacific), the committee had the job of filling out and sending the certificates we had offered. Though the HF bands were not cooperating for DX contacts, many were made via our ham satellites, so we had plenty of foreign requests for certificates.

Since we had so many modes of operation, our club members had an opportunity to become exposed to them; it was a fine training event for us too! Although I am a satellite operator at heart, after the event I soon became active in packet.

The club members were given tours of the *Ling* and told some fabulous stories of submarine life and the history of the *USS Ling*, making this one of our club's finest events. Obviously, all ham clubs don't have access to a submarine for a special event, but if you look around you might find an old steam locomotive, a historic building, an airfield, etc. But the location of the event isn't the most important thing. It's getting your club involved that will keep interest in your club high, and help promote our hobby with the public. We helped a submarine association and maybe you will help another historical society, a hospital, or a library. With Congress cutting back on pork, keeping important places, things, and moments in history alive will help promote amateur radio and provide a good public service. 73

Continued from page 79

attempt to squeeze out even more RF. This resulted in the model HPVFC, with a beefier final stage transistor. The HP stands for high power, of course. Final stage gain is the same, so I measured the same power output at 6 VDC as the VFC400 produced. However, the HPVFC can safely operate from a 9-volt source, which produced 300 milliwatts for me.

No Microscope Required

Photo A shows an HPVFC as it comes from the shipping box. It's about a half-inch longer than the VFC400. The Agrelo micro-rigs aren't kits, but they aren't plug-and-play either. All the hard work of mounting the dozens of tiny SMT parts has been done and the assembly has been tested and tuned. You must provide your own enclosure and solder in the wiring and connectors of your choice for antenna, power, and audio. Be careful, as there is no protection from damage due to reversed power polarity.

An important thing to consider in evaluating a fox transmitter is how it behaves as the battery becomes drained. If you do a good job of hiding your T, the hunt will take awhile and you might not be near your transmitter when the battery begins to poop out. Some other rigs I have encountered go far off frequency (maybe out of band!) or develop an audio howl as the input voltage is cut in half. They are completely unsuitable for use in an unattended station.

The Agrelo Ts that I tested scored well in this regard. The HPVFC audio remained clean as voltage was reduced to 1.8 volts. Below that, the oscillator shut off. Carrier frequency shift from 3 to 9 volts was 2 kHz. (Unfortunately, no frequency adjustment trimmer is provided.)

Even a QRP hidden transmitter has to be spectrally pure, because it may get hidden near an airport or other sensitive location. Remember, the second harmonics of a 2 meter signal are on frequencies used by aircraft! Hiders in Southern California like to put Ts on top of mile-high mountain peaks, where a few milliwatts can cover thousands of square miles.

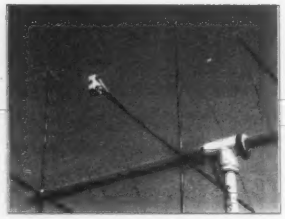


***Photo C.** The Yellowjacket quad is fed directly from RG-8X coax. About five turns of coax around the boom provide decoupling and matching.*

There are some other transmitters being sold to T-hunters that have not been reviewed by "Homing In" because I have found them to be spectrally "dirty." Output filters aren't difficult to include in base and mobile transceivers, but when you're trying to make a postage-stamp-sized rig, it becomes much more tricky. Rather than ignore the problem and pass it off by saying "It's a kit," Agrelo Electronics bit the bullet and figured out how to include a tiny two-stage low-pass filter in the HPVFC. My spectrum analyzer check of the HPVFC found that all harmonics and spurs above the carrier frequency were down -52 dB or better, easily surpassing the FCC requirement of -40 dBc for low-power VHF transmitters.

For its small size, the HPVFC is amazingly rugged. However, the unit I tested did not have heat sinking on the final stage. With a 9-VDC supply, the output transistor got quite hot and power output dropped 20 percent in less than a minute. Besides the power decrease, high-temperature operation can dramatically shorten final transistor life.

For low-duty intermittent signal hunts (less than 10-second transmissions and at least a minute between transmissions), temperature should not be a problem. Otherwise, I recommend adding some heat sinking to the final stage for operation above 6 volts. For instance, you could cement the flat surface of a 1/2" x 3/8" finned sink to the trimmer side of the board, behind the final transistor. The layer of cement must be very thin for good heat transfer. After installing your sink, use a regulated power supply and check power output versus time for your planned transmission timing. If power output drops more than 10 percent, you need more heat sinking.

Two frequencies are available from stock: 146.565 MHz and 145.79 MHz. 146.565 has become the de facto national simplex T-hunting frequency, recognized by coordinators in Southern California and elsewhere. 145.79 is used in much of the USA for Automatic Packet Reporting System (APRS), as described in several previous "Homing In" articles. APRS enthusiasts are discovering that HPVFC is a good choice for use in miniature stand-alone trackers. Agrelo Engineering will crystal your HPVFC on another 2 meter frequency of your choice for an additional $30.

New Quad for T-Hunting

For a simple, inexpensive and effective mobile T-hunting antenna for 2 meters, it's hard to beat a yagi or cubical quad. Just rotate the mast carefully to peak up the incoming signal on your receiver's S-meter, and the front of the antenna will be aimed in the signal source direction.

A four-element 2 meter quad certainly does not result in a "stealthy" RDF system. Nevertheless, it is the antenna of choice for Southern California mobile T-hunters because its high gain makes it possible to track signals at greater range. Once you figure out how to support and turn the mast in the passenger-side window frame and armrest, you can be ready to go T-hunting in a couple of hours.

It's easy to make a lightweight RDF quad for your favorite VHF or UHF band using ordinary PVC plastic plumbing supplies from your local hardware store. However, lots of hams have asked me how to buy one ready-made. Ed Buchanan KN6CL of the Fullerton Radio Club saw this as a business opportunity.

Ed says he's a pipe fitter by trade, but he has always liked to build antennas, particularly quads. That's what led him to buy the Cubex Antenna Company from Karl Scharping W6KWF about a year ago. "Cubex has been in business for 39 years," Ed says. "I bought an antenna from Karl in 1992 and at that time I asked him if he planned to sell his business. He was in his mid-80s, but he said he had never thought about it. But he called me a few months later and said he was considering retirement. We got together and struck up a deal."

Cubex is best known for ruggedly-constructed "monster quads" for DXers. W6KWF had never sold antennas for bands above 30 MHz. KN6CL decided that for Cubex to grow, it should add T-hunters and other VHF enthusiasts to the customer base.

The new Cubex Yellowjacket four-element 2 meter quad (Photo B) is quite similar to the strung-wire quad in my T-hunt book (see the sidebar),

***Photo D.** At the factory in Brea ,CA, technician Ed Hocking AB6N (left) puts another ready-to-ship 2 meter quad kit into its bag with help from new Cubex owner Ed Buchanan KN6CL.*

but Ed made some changes that make it more rugged. The boom is 1" O. D. tubular Fiberglas and the spreaders are quarter-inch-diameter solid Fiberglas rod. Elements are solid tinned copper wire. "I pre-stretch the wire when I make them so they are not going to sag," Ed says. All hardware is stainless steel.

For quickly changing wave polarization to match the signal (horizontal, vertical, or anything in between), the PVC boom-to-mast tee allows the boom to be rotated (Photo C). A worm-gear clamp adjusts the tension on this joint. You can slide the coupler as required to optimize mechanical balance.

Like Cubex HF quads, the Yellowjacket is shipped in kit form (Photo D). Color-coded tapes on the boom, spreaders, and elements make assembly quick and simple. You must provide the mast and coax. RG-8X is recommended for minimum loss and easy rotation.

The driven element is directly fed without a matching network. A coil of coax around the boom ahead of the driven element provides matching and decoupling. Adding turns to this coil moves the resonance point slightly higher in frequency. I found that five turns gave a near perfect match on 146.565 MHz.

I did far-field comparison tests of the Yellowjacket against my venerable stiff-wire quad, which I have used since I started T-hunting. This antenna (pictured on the cover of the T-hunt book) has nearly the same boom length and element spacing as the Yellowjacket, so I expected gain and

pattern to be quite similar. They were. Front-to-back, front-to-side ratios and 3 dB beamwidth were nearly identical. The forward lobe peak was squarely on axis.

The Yellowjacket had about 2 dB greater forward gain than my reference quad. Since gain and front lobe beamwidth are directly related (as explained on page 39 of the T-hunt book) and since both quads had nearly the same measured beamwidth, this was a surprise. Could it be that the oxidized wire on my old antenna has more loss due to "skin effect" than the shiny tinned element wire on the Yellowjacket? Guess it's time to retire the old quad!

I expected the thick-wall Fiberglas boom on the Cubex quad to make it noticeably heavier and harder to handle than the stiff-wire quad, but this was not the case. Of course, no mobile quad is completely safe from low-hanging tree branches, but this one should do quite well.

Now that Cubex has done the hardest part of making an RDF antenna for you, you should have no excuse for missing the fun of your club's next 2 meter RDF contest. See you on the hunt! 73

Product Information

Agrelo Engineering
1145 Catalyn Street
Schenectady NY 12303
Phone (518) 381-1057
FAX (518) 381-1058
E-mail jagrelo@aol.com
Web http://home.navisoft.com/agrelo/ae.htm

VFC400 transmitter $99.95, HPVFC transmitter $129.95. Add $5 shipping/handling. New York state residents add sales tax.

Cubex Antenna Company
2761 Saturn Street Unit E
Brea CA 92621
Phone (714) 577-9009
FAX (714) 577-9124

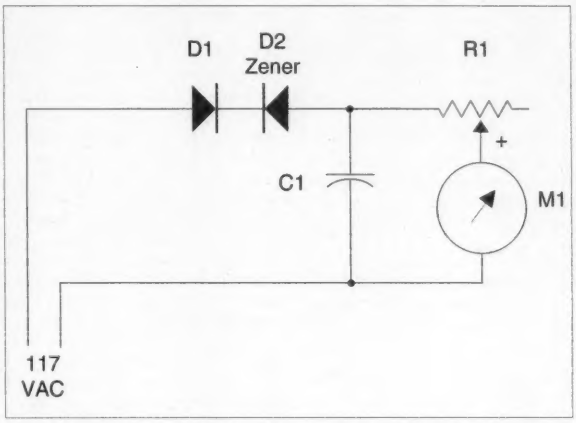
Yellowjacket 2 meter four-element quad $44.95 plus $6 shipping/handling. California residents add sales tax.

Construction plans and installation ideas for mobile strung-wire and stiff-wire VHF quads are in *Transmitter Hunting—Radio Direction Finding Simplified* by Joe Moell KØOV and Tom Curlee WB6UZZ. This 323-page reference book (TAB/McGraw-Hill #2701) covers all aspects of RDF and is available from Uncle Wayne's Bookshelf. #TAB2701 $19.95

Updates

In the January 1996 issue of *73*, we ran "Line Voltage Monitor" by J. Frank Brumbaugh KB4ZGC, beginning on page 86, without including Fig. 1, the circuit.

Here it is:



Number 85 on your Feedback card

Ham Help

We are happy to provide Ham Help listings free on a space available basis. To make our job easier and to ensure that your listing is correct, please type or print your request clearly, double spaced, on a full 8 1/2" x 11" sheet of paper. Use upper- and lower-case letters where appropriate. Also, print numbers carefully—a 1, for example, can be misread as the letters l or i, or even the number 7. Please remember to acknowledge responses to your requests. Thank you for your cooperation.

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If you are interested in amateur radio, and helicopter aviation, and would like to contact others with the same interests, there is a non-profit organization called "World Heli-Hams" that might be able to help. If interested, contact *Mr. Marden Pride, 34 Fountain St. A5, Haverhill MA 01830 USA. E-Mail: wblggi@gw.w1mx.ampr.org. Packet: WB1GGI @ K1UGM.#EMA.MA.USA.NOAM.*

Needed: Manuals for (1) IBM Portable PC Mod 5155; (2) CITIZEN 120D Dot Matrix Printer. *Peter A. Bergman NØBLX, 3517 Estate Dr. SW, Brainerd MN 56401. Tel. (218) 829-6286.*

Needed: Copy of alignment section of manual for HEATHKIT GR.78. I will pay for photocopies and postage. *Sam Cogar, P.O. Box 755, Houghton Lake MI 48629.*

Wanted: Manual and/or Schematics for the HEATHKIT SB-10 Single Sideband Adapter. *Roy Austin VE6RRA, Box 1388, Claresholm, AB Canada TØL ØTØ. Tel. (403) 625-4379. Compuserve 102215,1747.* 73

Ask Kaboom

Continued from page 78

I just assume the transistor is bad. Luckily, they nearly always fall open, not shorted, so there's usually no other damage to the horizontal circuitry. Replacing the transistor is as easy as simply soldering in a new one. Be sure to use heat-sink goo if there was some on the old part. By the way, you can get these transistors at most parts houses and TV shops. Even Radio Shack sells them. Expect to pay between about three and seven dollars. Unlike with many other parts, you don't need an exact cross-referenced replacement. They're all NPN, and just about any horizontal output transistor will work in the average-sized monitor. But please don't even consider putting in any kind of transistor other than one made for horizontal output service; it won't work and probably will blow faster than you can hit the "off" switch, possibly doing further damage to the monitor!

Try It

Check the fuses in the power supply. If there's a bad one, change it. Now, give it a try! If you're lucky, your monitor will come to life. If you have a computer connected, you should get a picture. With no computer connected, the screen may remain completely dark, but you should hear that lovely high-voltage crackle, and touching the front of the screen should give you some static electricity. That means the horizontal and high voltage are working, and, most likely, so is the whole set. If it does work, take a look at the back of the picture tube to be sure the filaments are on. They should glow a dull orange.

Nada

If it still doesn't work, your task is not yet complete. Next time, we'll continue this topic, looking toward the power supply. Until then, 73 from KB1UM. 73

If time and/or money were not a factor, what ham equipment would you prefer? What would you do hamming-wise differently than you do now? Write: 73 Wish List, 70 R 202 N, Peterborough NH 03458

Number 86 on your Feedback card

BARTER 'N' BUY

Turn your old ham and computer gear into cash now. Sure, you can wait for a hamfest to try and dump it, but you know you'll get a far more realistic price if you have it out where 100,000 active ham potential buyers can see it than the few hundred local hams who come by a flea market table. Check your attic, garage, cellar and closet shelves and get cash for your ham and computer gear before it's too old to sell. You know you're not going to use it again, so why leave it for your widow to throw out? That stuff isn't getting any younger!

The 73 Flea Market, Barter 'n' Buy, costs you peanuts (almost)--comes to 35 cents a word for individual (noncommercial) ads and $1.00 a word for commercial ads. Don't plan on telling a long story. Use abbreviations, cram it in. But be honest. There are plenty of hams who love to fix things, so if it doesn't work, say so.

Make your list, count the words, including your call, address and phone number. Include a check or your credit card number and expiration. If you're placing a commercial ad, include an additional phone number, separate from your ad. This is a monthly magazine, not a daily newspaper, so figure a couple months before the action starts; then be prepared. If you get too many calls, you priced it low. If you don't get many calls, too high.

So get busy. Blow the dust off, check everything out, make sure it still works right and maybe you can help make a ham sure it still works right and maybe you can help make a ham newcomer or retired old timer happy with that rig you're not using now. Or you might get busy on your computer and put together a list of small gear/parts to send to those interested?

Send your ads and payment to: *73 Magazine*, Barter 'n' Buy, 70 Rt. 202N, Peterborough NH 03458 and get set for the phone calls. The deadline for the April 1996 classified ad section is February 12, 1996.

ALL ABOUT CRYSTAL SETS. Theory and construction of crystal set radios. $9.95 each, ppd. USA. Send to: **ALLABOUT BOOKS**, Dept. S, P.O. Box 22366, San Diego CA 92192. BNB200

NOW ON 40 METERS! NEW, KNOB-TUNED w/DIGITAL DISPLAY, SYNTHESIZED QRP transceiver. Complete kit only $199.95. S&H $7.50 (continental US). GUARANTEED TO WORK. For info send SASE: Call/write to order: **S & S ENGINEERING,** 14102 Brown Road, Smithsburg MD 21783; (301)416-0661. BNB334

RCI-2950/2970: New modification manual including Power increase. Clarifier modification. Modulation increase. Operating hints, and more. Parts included. Only $20.00 ppd. in U.S. (Missouri residents add $1.15 tax). **SCOTT**, P.O. Box 510408, St., Louis MO 63151-0408. (314)846-0252. Money Orders or C.O.D. BNB340

NI-CD BATTERY analyzer cycler. PC controlled. DOS software. $289 PO Box 672, London, Ontario Canada N6A 4Y4 **Lamantia Products** 519-472-5566 Fax 519-472-1702 BNB385

IT'S BACK! The return of the HW-8 Handbook! Second print ing. Modifications for the Heath QRP rigs. First class mail $11. DX add $4 for air mail shipping. **Mike Bryce, WB8VGE,** 2225 Mayflower NW, Massillon OH 44647. BNB404

HEATHKIT WANTED! S.B. Series **'Green Front'** for parts. **Robert Schlegel** 2302 286th St. East, Roy WA 98580 BNB910

MAHLON LOOMIS, INVENTOR OF RADIO; by Thomas Appleby, (Copyright 1967). Second printing available from **JOHAN K.V. SVANHOLM, N3RF, SVANHOLM RESEARCH LABORATORIES,** P.O. Box 81, Washington DC 20044. Please send $25.00 donation with $5.00 for S&H BNB420

HAMS—NEED COMPUTER RIBBONS? Lowest prices. Color or black. State your needs. Free info. **HARCLY(I),** P.O. Box 830A, Coquille, OR 97423 BNB457

ELECTRON TUBES: All types and sizes. Transmitting, receiving, microwave . . . Large inventory = same day shipping. **DAILY ELECTRONICS,** 10914 NE 39th ST. Suite B-6, Vancouver, WA 98682. (800)346-6667 or (360)896-8856. BNB719

SUPERFAST MORSE CODE SUPEREASY. Subliminal cassette. $12. **LEARN MORSE CODE IN 1 HOUR.** Amazing supereasy technique $12. Both $20. Money back guarantee. Free catalog: SASE. Bahr-T2, 150 Greenfield, Bloomingdale, IL 60108. BNB1025

PACKET RADIO. Join **TAPR,** connect with the largest packet/digital group in the U.S. Creators of the TNC-2 standard. Benefits: newsletter, software, discount on kits/publications. $15/year U.S., $18 Can/Mex, $25 elsewhere. Visa/MC. When joining, mention 73, receive **TAPR'S** new book, Packet Radio: What? Why? How? ($9 value) **FREE!** Internet: tapr@tapr.org Web: http://www.tapr.org (817) 383-0000 Mail: 8987-309 E. Tanque Verde Rd. #337, Tucson, AZ 85749-9399 BNB1027

WANTED: HAM EQUIPMENT AND RELATED ITEMS. Donate your excess gear, new-old-in-any-condition to the Radio Club of Junior High School 22, the Nation's only full-time, nonprofit organization working to get Ham Radio into schools around the country as a teaching tool using our EDUCOM—Education Thru Communication— program. Send your radio to school. Your donated material will be picked up ANYWHERE or shipping arranged, and this means a tax deduction to the full extent of the law for you as we are an IRS 501(c)(3) charity in our 15th year of service. It is always easier to donate and usually more financially rewarding, BUT MOST IMPORTANT your gift will mean a whole new world of educational opportunity for children nationwide. Radio's you can write off, kids you can't. Make 1996 the year to help a child and yourself. Write, phone or Fax the **WB2JKJ "22 Crew"** today: The RC of JHS 22, POB 1052, New York, NY 10002. 24 hours call 516-674-4072 or Fax 516-674-9600. Join us on the WB2JKJ CLASSROOM NET, 7.238 MHz 1200-1330 UTC daily, and 21.395 MHz from 1400 to 2000 UTC. Meet us at the upcoming Charlotte Hamfest. BNB762

QSL CARDS Many styles. Top quality. Order Risk Free. Plastic cardholders, T-Shirts, Personalized caps, mugs, shirts. Other ham shack extras. Information and samples. **Rusprint.**1- 800-962-5783. BNB1021

R-390A SALES & SERVICE. INFO SASE MILTRONIX P. O. Box 80041 TOLEDO, OHIO 43608. R-390 POWER INPUT CABLES $25.00, ANTENNA CONNECTORS $12.50, EXTERNAL AGC MOD $20.00 PPD. MON.-FRI.. 9AM-6PM E.S.T. (419) 255-6220. BNB813A

WANTED: BUY AND SELL All types of Electron Tubes. Call (612)429-9397, Fax (612)429-0292. **C & N ELECTRONICS,** Harold Bramstedt, 6104 Egg Lake Road, Hugo MN 55038. BNB915

HEATH COMPANY is selling photocopies of most Heathkit manuals. Only authorized source for copyright manuals. **Phone** (616)925-5899, 8-4 ET. BNB964

PRINTED CIRCUIT BOARDS for projects in *73, Ham Radio, QST,* ARRL Handbook. List SASE. **FAR CIRCUITS,** 18N640 Field Ct., Dundee IL 60118. BNB966

COMMODORE 64 HAM PROGRAMS- 8 disk sides over 200 Ham programs $16.95. 32 cents stamp gets unusual software catalog of Utilities, Game and British Disks. **HOME-SPUN SOFTWARE,** Box 1064-BB, Estero FL 33928. BNB1052

AZDEN SERVICE by former factory technician. **SOUTHERN TECHNOLOGIES AMATEUR RADIO INC.,** 10715 SW 190 St. #9, Miami FL 33157. (305) 238-3327. BNB979

CODE 5 News and Petition information. SASE to **KB7PNQ**, 503 Dubois Street, Cheney, WA 99004. BNB1012

ICOM IC-735 HF All Band Transceiver $500.00 OBO **(907) 235-5655.** BNB1051

RESTRICTED Top Secret Hacker Information. Cellular / Cable / Surveillance / Satellite / VideoCipher / Books / Videos - Software. Make $100/hour. Catalog - $3.00. **TELECODE** P.O. Box 6426-BNB, YUMA AZ 85366-6426. BNB1024

WANTED: Western Electric Audio Equipment. Amplifiers, pre-amps, tubes, speakers, parts, mixing boards, etc. **1-800-251-5454.** BNB1050

CHIPSWITCH - To give your **HR-2510** and **HR-2600** the same features the **BIG RIGS**, call (707) 539-0512 or write to **CHIPSWITCH** at 4773 Sonoma HWY. #132, Santa Rosa, CA 95409 for **FREE** information. BNB1033

Morse Code Computer Interfaces $49.95, with CW Filter $79.95, Free IBM Shareware and Ham Catalog. **Dynamic Electronics,** Box 896, Hartselle, AL 35640, 205-773-2758, FAX-773-7295. BNB1034

DTMF Radio Telephone Interface. Build your own. Simple step by step manual with schematics - $11.95. P.O. Box 237, Rock Spring, GA 30739. BNB1035

Surplus Electronic Microwave Equipment: 2 CTI 4204 MHz Oscillators, 2 HP 10811E 10 MHz Oscillators, 2-18 MHz Mixers, 2-18 MHz Power Dividers. **Kevin Bell**, 30600 County Rd. #9, Elizabeth, CO 80107. (303) 646-3534. BNB1003

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Code Tapes

73T05 **Genesis 5 wpm code tape** This beginning tape takes you through the 26 letters, 10 numbers and necessary punctuation complete with practice every step of the way. $5.95

73T06 **The Stickler 6 wpm code tape** This is the practice tape for those who survived the 5 wpm tape and it is also the tape for the Novice and Technician licenses. It is comprised of one solid hour of code. Characters are set at 13 wpm and spaced at 5 wpm $5.95

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73T20 **Courageous 20+ wpm coce tape** Go for the extra class license. We send the code faster than 20 per. $5.95

73T25 **Mind Boggler 25+ wpm code tape**. $5.95

SPECIAL EVENTS

Listings are free of charge as space permits. Please send us your Special Event two months in advance of the issue you want it to appear in. For example, if you want it to appear in the April issue, we should receive it by January 31. Provide a clear, concise summary of the essential details about your Special Event.

FEB 3

AMARILLO, TX The 1st Annual Amarillo ARES/RACES Hamfest and Severe Weather Emergency Comm. Expo will be held at the Texas Army Nat'l. Guard Armory, 2904 Tee Anchor Blvd. Events include NWS Skywarn Spotters School, APRS demo, ATV demo, VE Exams, 3933 Net Meeting, Flea Market, and more. Sponsored by Potter County ARES, and Amarillo, Potter, Randall RACES. Call *Ben Pollard WS5R at (806) 381-8810;* or write *ARES, P.O. Box 5378, Amarillo TX 79117.*

FEB 10

NORTH CHARLESTON, SC The 23rd Annual Charleston Hamfest and Computer Show will be held 8:30 AM–4 PM at Stall H.S. Talk-in on 146.79, the WA4USN Linked Rptr. System aboard the USS Yorktown, and the 145.25 Rptr. near Summerville. Walk-in VE Exams will be given on site. Bring original and copy of your license, any CSCEs you have, and two IDs, one with a photo. Exams begin at 12 noon. For Exam info, call *Ed KC4OOZ at (803) 871-4368,* or *Gary AC4PL at (803) 766-3440.* For Hamfest info, contact *Jenny Myers WA4NGV, 2630 Dellwood Ave., Charleston SC 29405-6814. Tel. (803) 747-2324.*

FEB 11

LATROBE, PA The Chestnut Ridge ARC's 2nd Annual Latrobe Winterfest Hamfest and Computer Show will be held 8 AM–3 PM at Latrobe American Legion, 1811 Ligonier St. Talk-in on 145.150 (-600). For reservations and info, contact *Chris Weiss K3JDU, (412) 537-6068; Carol Demosky N3UVA, (412) 539-1552;* or *Cliff Britt N3NBE* (via Packet) *N3NBE@KA3JSD.SWPA.WPA.PA.* Please send all payments to *C.R.A.R.C., P.O. Box 175, Loyalhanna PA, 15661-0175.*

MANSFIELD, OH The Mansfield Mid-Winter Hamfest/Computer Show will be held at the Richland County Fairgrounds in Mansfield, starting at 7 AM. Talk-in on W8WE 146.34/.94. Contact *Pat Ackerman N8YOB, 63 N. Illinois Ave., Mansfield OH 44905;* or phone *(419) 589-7133 after 6 PM EST.* Sponsor: InterCity ARC.

FEB 16–18

ORLANDO, FL The ARRL State Convention and 50th Anniversary Orlando HamCation Show and Computer Show will be held Fri. 5 PM–9 PM; Sat. 9 AM–5 PM; Sun. 9 AM–4 PM at Central Florida Fairgrounds on Rt 50. Forums by ARRL and NASA. 3 DX Presentations, MARS, and Ladies Programs. Talk-in on 146.760. For info and advance tickets, contact *Orlando HamCation, P.O. Box 547811, Orlando FL 32854;* or *Ken Christenson, (407) 291-2465; or E-Mail KD4JQR@aolcom.com.*

FEB 17

ROSEVILLE, MI The L'Anse Creuse ARC will hold an amateur radio Open House at the Macomb Mall, for the purpose of introducing ham radio to the public. They will operate KB8YUV 1500 UTC–2100 UTC and will invite visitors to join them on the air. Operation will be phone and CW in the General portion of the 80 through 10 meter bands. Contact *Dave Herrington N8NLK, (810) 465-2797;* or by e-mail at *dharring@macomb.lib.mi.us.*

SALEM, OR The Salem Rptr. Assoc. and Oregon Coast Emergency Rptr., Inc. will co-sponsor the 1996 Salem HamFair at the Polk County Fairgrounds in Rickreal OR, 9 AM–4 PM. Swap table setup 6 PM–9 PM Fri. night, and 7 AM Sat. morning. Talk-in on the 146.86 Rptr. Flea Market, Dealers, and Exhibits. Contact *Evan Burroughs N7IFJ, (503) 585-5924.*

TRAVERSE CITY, MI The Cherryland ARC will host their 23rd Annual Swap-n-Shop at Immaculate Conception M.S., 8 AM–Noon. VE Exams following the Swap. Talk-In on 146.86. Contact *Joe W8TVT* at *(616) 947-8555;* or *Chuck W8SGR at (616) 946-5312.*

FEB 18

DAVENPORT, IA The 25th Annual Davenport ARC Hamfest will be held 7:30 AM–3:30 PM at the QCCA Expo Center, 2621 4th Ave., Rock Island IL. Talk-in on the WØBXR 146.28/.88 Rptr. For info, tickets, reservations, SASE to *Kent Williams K9UQI, 4245 10th St., East Moline IL 61244-4154.* For VE Exams, SASE to *Roger Franke K9AYK, 2506 E. 29th Court, Davenport IA 52803.*

FEB 24–25

CINCINNATI, OH The ARRL Great Lakes Div. Convention 1996 will be held at Cincinnati Gardens Exhibition Center, 2250 Seymour Ave., Langdon Farm Rd., 8:20 AM–5 PM Sat. and Sun. All indoors. VE Exams. Flea Market. Accomodations at the Quality Hotel, Central, Norwood OH, (513) 351-6000. For info contact *Stan Cohen WD8QDQ, Chairman, 2301 Royal Oak Ct., Cincinnati OH 45237. Tel. (513) 531-1011.*

FEB 25

CUYAHOGA FALLS, OH The Cuyahoga Falls ARC, Inc. will sponsor their 42nd Annual Hamfest Computer Show/Flea Market at Emidio & Sons, 48 Bath Rd. Tables must be reserved in advance. For details, call *Carl N8JLQ, (216) 497-7047.*

LIVONIA, MI The Livonia ARC will present its 26th Annual Swap 'n Shop 8 AM–3 PM at the Dearborn Civic Center, Dearborn MI. ARRL/VE Exams. Talk-in on 144.75/5.35. For info, send 4" x 9" SASE *c/o Neil Coffin WA8GWL, Livonia ARC, P.O. Box 2111, Livonia MI 48151. Tel. (313) 261-5486.*

NEW WESTMINSTER, BC, CANADA The Burnaby ARC will host their Annual Flea Market at Westminster Armouries, 6th St. at Queens. Setup at 0900; buyers from 1000–1400. Talk-in on VE7RBY, 145.35 or 442.85. Please contact the club net Monday nights at 2000 local time on 145.35; or write the club at *Box 72012, 4429 Kingsway, Burnaby BC V5H 4P9, Canada.*

PITTSBURGH, PA AN ARRL-Sanctioned Hamfest and Computer Show, sponsored by the South Hills ARC, will be held 8 AM–3 PM at Castle Shannon VFD Memorial Hall, Route 88 (Library Rd.), Castle Shannon PA. Talk-in on 146.955(-) and 146.46 simplex. For tickets and reservations contact *Hamfest Chairman: Steve Lane N3RNY, P.O. Box 11626, Pittsburgh PA 15228. Tel. (412) 341-1043.*

MAR 2

ABSECON, NJ The Shore Points ARC will sponsor its 14th annual hamfest, "Springfest '96," at Holy Spirit H.S. on Route 9 (3/4 mi. south of Route 30), starting at 9 AM. Setup at 7 AM. Flea Market. Talk-in on 146.385/.985. For info, write to *SPARC, P.O. Box 142, Absecon NJ 08201.*

MAR 3

BRAINTREE, MA A Ham Radio Flea Market will be sponsored by the South Shore ARC 9:30 AM–2 PM at DAV #29 Hall on Liberty St. Set-up at 8 AM. No tailgating in the parking lot! Talk-In on 146.67(-) Quincy Rptr. VE Exams for pre-reg. participants. Parking in Parking Lot only (no side streets or yards). Contact *William Morgan, 25 Helena Rd., Boston MA 02122.*

SPECIAL EVENT STATIONS

FEB 11

SEATTLE, WA The 3rd Annual NW QRP Club Winter Sprint will be held 1800 UTC–2259 UTC. Freq.: CW—3560–3580, 7035–7040, 14060, 21060 kHz. SSB—14285, 21385, 28385 kHz. Send completed logs by Feb. 29th, 1996 to *Stan Yarema KG7ME, Contest Editor, 3457 12th West, Seattle WA 98119.*

FEB 17–18

ALEXANDRIA, VA The Mount Vernon ARC will operate N4BV 1600Z–2200Z Feb. 17th–18th, to commemorate George Washington's Birthday. Operation will be in the lower General 80–15 meter phone subbands, and in the Novice 10 meter subband. For a certificate, send QSL and a 9" x 12" SASE to *MVARC, P.O. Box 7234, Alexandria VA 22307.*

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AR4661 **ARRL's Antennas & Techniques for Low-Band DXing** can be your ticket to low-band success. $20.00

AR3851 **Hints and Kinks** Ideas for setting up your gear for comfortable efficient operation. $10.00

ARRL **License Manuals:**
AR4181 **Technician Class** $6.00
AR4688 **General Class** $12.00
AR3274 **Advanced Class** $8.00
AR3272 **Extra Class** $8.00

AR3185 **The Satellite Experimenter's Handbook** by Martin Davidoff K2UBC Expanded and revised. Focusing on satellites built by and for the international radio amateur community $20.00

AR4645 **Satellite Anthology** The latest information on OSCARs 9 throu 13 as well as the RS satelites, the use of digital modes, tracking antennas, RUDAK, microcomputer, and more! $10.00

AR4483 **Weather Satellite Handbook** by Dr. Ralph Taggart WA8DQT. Expanded and revised to reflect today's weather-fax satellite technology. $20.00

AR4653 **Companion Software for Weather Satellite Handbook** 5-1/4" MS-DOS floppy $10.00

AR2973 **Complete DX'er** by Bob Locker W9K1 Learn how to hunt DX and obtain hart-to-get QSL cards. $12.00

PROPAGATION

Jim Gray W1XU
210 Chateau Circle
Payson AZ 85541

Old Sol is staging a surprise for all of us! The first spots of solar cycle 23 have appeared about 30 degrees north (and south) of the sun's equator, along with old spots of Cycle 22 near the equator. The polarities of Cycle 23 spots are the opposite of those of Cycle 22 spots. It looks as if Cycle 22 will be—or has been—shorter than normal (about 9.5 to 10 years instead of 10.5 to 11.5 years), as I suggested more than a year ago. In fact, it is possible that the sun spot minimum may occur as early as June this year, accompanied by rapidly increasing solar flux levels not long thereafter. The "up" side plot of solar flux values for any cycle is usually steeper than the "down" side plot, so rejoice!

10-12 Meters

February is shaping up as a very good month for DXers, I think. The *best* days (G) are Feb. 1 to Feb. 4, and Feb. 12 to Feb. 21. The *worst* days (P) are likely to be Feb. 7 and Feb. 8, and Feb. 24 to 29. Yes, that's right, this is leap year, and February has 29 days. On Good days, the higher bands will be open longer and signal strengths better than last month, as we approach the Spring equinox, and you may find some surprising and welcome activity on 10 and 12 meters.

15-17 Meters

The 17-meter band has been quite good all through 1995, with some excellent openings—at times very much like 20 meters. I expect this will improve in 1996, and you may see 15 meters come alive, too.

20-160 Meters

Twenty meters, as always, will be your dependable DX band, while 30 and 40 continue their excellent winter ways, as do 80 and 160, but these latter two bands will soon begin to show signs of Spring with (QRN) and a poorer Signal-to-Noise ratio. 73

FEBRUARY 1996

SUN	MON	TUE	WED	THU	FRI	SAT
				1 G	2 G	3 G
4 G	5 F	6 F-P	7 P	8 P	9 P-F	10 F
11 F-G	12 G	13 G	14 G	15 G	16 G	17 G
18 G	19 G	20 G	21 G	22 G-F	23 F-P	24 P
25 P	26 P	27 P	28 P	29 P		

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA							20	20				
ARGENTINA	20	40	40	40	80	80				20	15	15
AUSTRALIA	20		20		40	40	20	20			15[1]	15[1]
CANAL ZONE	15	20	20	40	40		20	20	15	15	15*	15*
ENGLAND	20	40	80	40	40		20	20	20	20	20	20
HAWAII	20		20		40	40	80	20			15[1]	15[1]
INDIA						20[1]	40[1]	20[1]				15[1]
JAPAN	20						20	20				20
MEXICO	15	20	20	40	40		20	20	15	15	15*	15*
PHILIPPINES							20					
PUERTO RICO	15	20	20	40	40		20	20	15	15	15*	15*
SOUTH AFRICA			40[1]	40[1]				15	15	15	20	20
U.S.S.R.	40	80	80	40			20	20	20			40
WEST COAST		80	80	40	40	40	20	20	20			

CENTRAL UNITED STATES TO:

ALASKA						80*	40*	20				
ARGENTINA	20		40	40	40						15	15
AUSTRALIA	15					40	20	20	20			15
CANAL ZONE	20	80	40	40	40	40	20	20	15	15	15	20
ENGLAND	40	40	40	80				20	15	20		40
HAWAII	15	20			40	40	40				15	15
INDIA	15[1]	20[1]	20[1]				40[1]	20[1]	20[1]			
JAPAN						80*	40*	20				
MEXICO	20	80	40	40	40	40	20	20	15	15	15	20
PHILIPPINES								20				
PUERTO RICO	20	80	40	40	40	40	20	20	15	15	15	20
SOUTH AFRICA	20	40*							15	15	20	20
U.S.S.R	40		40	40				20	20			

WESTERN UNITED STATES TO:

ALASKA	15	20			40	40	40	40	40			20
ARGENTINA	15	20		40	40	40	40	40		15	15	15
AUSTRALIA	15	20	20				40	80*	40	15	15	15
CANAL ZONE	20	20		40	40	40			20	15	15	15
ENGLAND			80*	40					20	20		
HAWAII	15	15			20	20	20	20				15
INDIA		20										
JAPAN	15	20			40	40	40	40	40			20
MEXICO	20	20		40	40	40			20	15	15	15
PHILIPPINES	15	20					40	40		20		20
PUERTO RICO	20	20		40	40	40			20	15	15	15
SOUTH AFRICA	20	40[1]	40[1]							15	15	20
U.S.S.R.		40[1]	40[1]	40[1]	40[1]				20	20		
EAST COAST		80	80	40	40	40	20	20	20			

1Check next higher band
*Bp-Meters possible on good days only

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2/96

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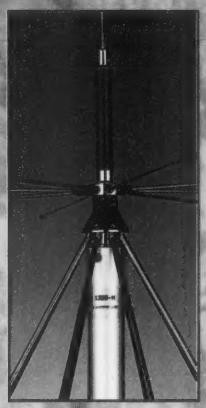
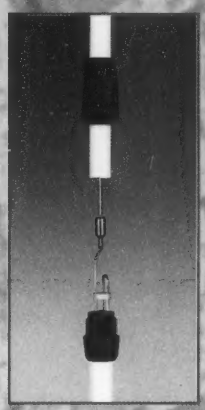
TECHNICAL DATA

Type:	VHF - UHF wide-band DISCONE
Impedance:	50 Ω
Frequency range:	Rx 25-1300 MHz
VHF Tx Band:	49-51/120-180/215-300 MHz
UHF Tx Band:	415-465/610-650/710-1000/1130-1300 MHz
Polarization:	vertical
V.S.W.R.: at freq. res.:	≤ 1.3:1
Gain:	0 dBd - 2.15 dBi
Max Power:	VHF 300 Watts ;UHF 200 Watts
Connection:	
SD 1300 U:	"UHF" female
SD 1300 N:	"N" female
Wind resistance:	40m/second
Length (approx.):	1700 mm
Base diameter:	850 mm
Weight (approx.):	1300 gr
Mounting mast:	ø 25-54 mm



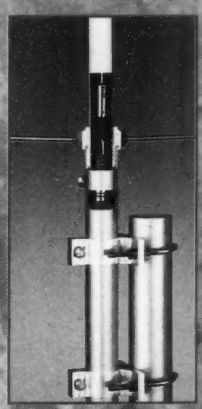
SD 1300 U/N



TECHNICAL DATA

Type:	VHF 6/8 λ UHF 3 x 5/8 λ Ground Plane
Impedance:	50 Ω
Frequency range:	VHF 142-148 MHz UHF 430-440 MHz
Polarization:	vertical
V.S.W.R. at freq. res.:	≤ 1.2:1
Bandwidth: at VSWR 2:1:	VHF 6 MHz, UHF 15 MHz
Gain:	VHF 4 dBd - 6.15 dBi UHF 6.85 dBd, 8.15 dBi
Max Power:	200 Watts
Connection:	"N" Female
Wind resistance:	60m/second
Length (approx.):	1800 mm
Radial length (approx):	170 mm
Weight (approx.):	950 gr
Mounting mast:	ø 35 - 54 mm

SA 270 MN



SIRIO antenne

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Light Sensation

User-friendly operation

Fingertip convenience. Both the TH-22AT (144 MHz) and TH-42AT (440 MHz) feature an easy-to-use menu system with programming and simple operation for the new operator as well as the veteran.

Compact rugged design

Measuring just 2-3/16 x 4-5/8 x 1" (56 x 117 x 25mm), these transceivers are so small and slim that they can easily slip into your shirt pocket. The TH-22AT/TH-42AT are remarkably light, yet reassuringly built tough.

Efficient MOS FET power module

The FET power module generates high output power (5 watts with only 9.6 V input) from a PB-34 battery, providing many additional hours of enjoyment. The supplied 6 V PB-32 battery pack provides up to 3 watts (TH-22AT) or 2.5 watts (TH-42AT).

Direct DC - in terminal

Power source versatility goes a step further: you can remove the battery power source completely and use a direct DC (5.0 V~16.0 V) source from your car or home using the PG-3H filtered cigarette lighter cord or the PG-2W DC cable for a full 5 watts (9.6 V~16.0 V) of power.

Great receive audio output

In the famous Kenwood tradition, the 1-7/16" speaker offers outstandingly clear audio quality.

40 non-volatile memory channels + 1 call channel

All 41 memory channels can independently store essential data—transmit and receive frequencies, frequency step, tone (CTCSS) frequency, tone on/off, CTCSS on/off, DTSS code, DTSS on/off, shift reverse on/off—all in a non-volatile E2PROM. There's no need for a lithium battery backup.

Luminescent DTMF keypad

The DTMF keypad enables direct frequency entry (in VFO mode) and direct recall of memory channels (in MR mode). The DTMF memory function allows storage of up to (5) commonly used auto-dial telephone numbers for autopatch use. The luminescent keypad helps increase operating convenience while no additional battery drain is required.

TH-22ATK2 version

If you prefer to custom tailor your own TH-22AT, you can choose the low-cost TH-22ATK2. You now have 8 different power and charging options including (3) NiCad battery options (PB-32, PB-33, PB-34), an AA alkaline battery pack (BT-9), or start with just the PG-2W power cord for DC power input.

Other Features

- DTSS & page
- DTMF memory (5 x 15-digit codes) & transmit hold
- Multiple scan & scan stop modes
- Busy channel lock-out
- Tone alert with elapsed time indicator
- Selectable squelch configuration
- Key lock
- Time-out timer (30, 60, 90, 180, 900 sec.)
- Auto battery-saver circuit
- LCD with 2 backlight modes (on demand or continuous)
- 3-level RF output power control
- Built-in CTCSS encoder and optional decoder
- Auto power-off
- Auto repeater offset (TH-22AT)
- Battery voltage indicator
- Modifiable for MARS/CAP*

*Permits required for MARS/CAP use. Specifications guaranteed for Amateur bands only. Kenwood follows a policy of continuous advancement in development. For this reason specifications may be changed without notice.

TH-22AT/42AT

FM HANDHELD TRANSCEIVER

ISO 9002 Meets ISO Manufacturing Quality System

KENWOOD

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